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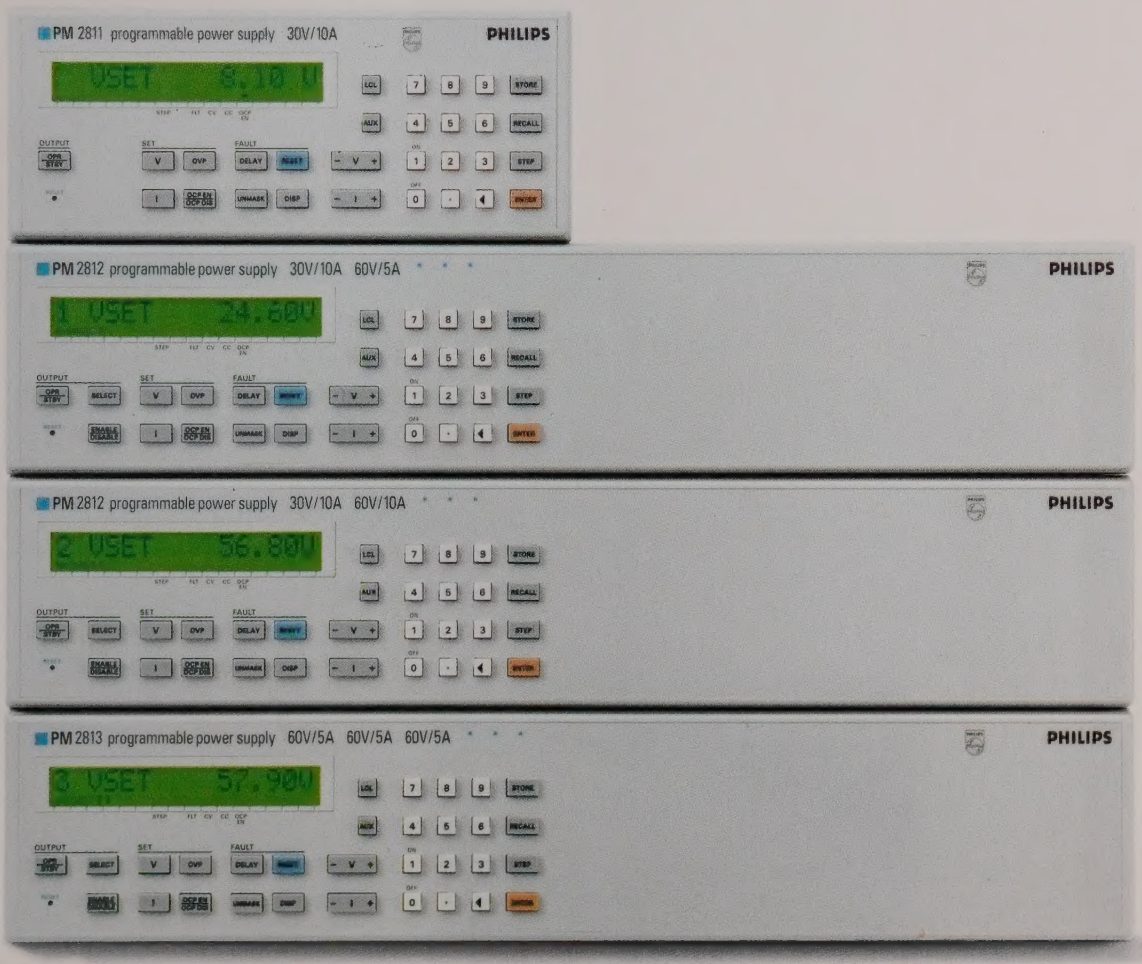
SERVICE
SUPPLEMENT

C. 1

PM2811 - PM2812 - PM2813
PROGRAMMABLE POWER SUPPLIES

Service Manual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PM 2813 programmable power supply 60V/5A 60V/5A 60V/5A
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PM2811 - PM2812 - PM2813
Programmable Power Supplies

Service Manual

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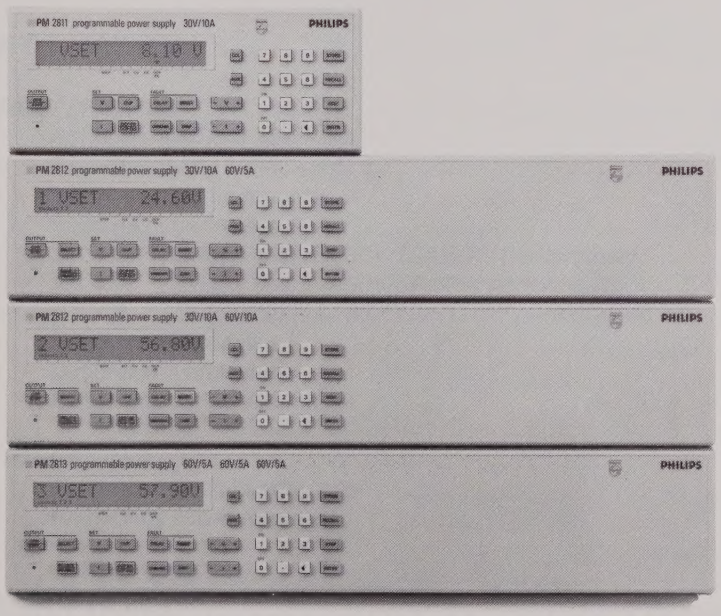
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PM 2813 programmable power supply 60V/5A 60V/5A 60V/5A
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WARNING: **These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operation instructions unless you are fully qualified to do so.**

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IMPORTANT

In correspondence concerning this instrument, please give the model number and serial number as located on the type number plate on the instrument.

For your reference:

Model number: PM28xx/yyy
Serial number: DY nn mmmm

NOTE: The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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TABLE OF CONTENTS

Page

1 SAFETY INSTRUCTIONS 1-1

1.1 INTRODUCTION 1-1

1.2 SAFETY PRECAUTIONS 1-1

1.3 CAUTION AND WARNING STATEMENTS 1-1

1.4 SYMBOLS 1-1

1.5 IMPAIRED SAFETY 1-2

1.6 GENERAL SAFETY INFORMATION 1-2

2 GENERAL INFORMATION 2-1

2.1 CHARACTERISTICS 2-1
2.1.1 Performance Characteristics 2-1
2.1.2 Environmental Characteristics 2-1
2.1.3 Mechanical requirements 2-1
2.1.4 Instrument performance 2-2
2.1.4.1 Output channel 30V/10A/60W performance 2-2
2.1.4.2 Output channel 60V/5A/60W performance 2-4
2.1.4.3 Output channel 60V/10A/120W performance 2-5
2.1.5 Safety characteristics 2-7
2.1.6 Dimensions and weight 2-8
2.1.7 Mains Supply Conditions 2-8

2.2 INTERFERENCES 2-8
2.2.1 Electromagnetic interference 2-8
2.2.2 Frequency interference 2-8

3 CIRCUIT DESCRIPTIONS 3-1

3.1 DESCRIPTION OF EACH CIRCUIT SECTION 3-1
3.1.1 CPU PCB, unit A1 3-1
3.1.2 DISPLAY KEYBOARD PCB, unit A2 3-5
3.1.3 AD-DA PCB, unit A3 3-5
3.1.4 Output on the front panel 3-9
3.1.5 Input module 3-10
3.1.5.1 Setting the power voltage 3-10

4 PERFORMANCE VERIFICATION PROCEDURES 4-1

4.1 GENERAL INFORMATION 4-1

4.2 RECOMMENDED TEST EQUIPMENT 4-1

5 DISASSEMBLING THE INSTRUMENT 5-1

5.1 GENERAL INFORMATION 5-1

5.2 REMOVING THE COVER 5-1

5.3 DISASSEMBLING THE INSTRUMENT 5-1

5.4 REASSEMBLING THE INSTRUMENT 5-2

6 CALIBRATION ADJUSTMENT PROCEDURE 6-1

6.1 GENERAL INFORMATION 6-1
6.1.1 Recommended test equipment for local calibration 6-1
6.1.2 Recommended test equipment for remote calibration 6-1

6.2 CALIBRATION PROCEDURES 6-1
6.2.1 Local calibration procedure 6-1
6.2.2 Remote calibration procedure 6-4

7 CORRECTIVE MAINTENANCE PROCEDURES 7-1

7.1 HARDWARE-ERROR MESSAGES 7-1

7.2 TROUBLESHOOTING 7-2
7.2.1 Introduction 7-2
7.2.2 CPU PCB 7-2
7.2.3 AD-DA PCB 7-3

7.3 REPLACEMENTS 7-3
7.3.1 Standard parts 7-3
7.3.2 Special parts 7-4
7.3.3 Transistors and integrated circuits 7-4

7.4 RECALIBRATION AFTER REPAIR 7-4

7.5 INSTRUMENT REPACKING 7-4

8 SAFETY INSPECTION AND TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT 8-1

8.1 GENERAL DIRECTIONS 8-1

8.2 SAFETY COMPONENTS 8-1

8.3 CHECKING PROTECTIVE GROUND 8-1

8.4 CHECKING INSULATION RESISTANCE 8-1

8.5 CHECKING LEAKAGE CURRENT 8-1

8.6 VOLTAGE TEST 8-1

9 PARTS LIST 9-1

10 WIRING DIAGRAM 10-1

1 SAFETY INSTRUCTIONS

Read these pages carefully before beginning to install and use the instrument.

1.1 INTRODUCTION

The following paragraphs contain information, cautions and warnings which must be followed to ensure safe operation and to keep the instrument in a safe condition.

WARNING: Servicing described in this manual is to be done only by qualified service personnel. To avoid electrical shock, do not service the instrument unless you are qualified to do so.

1.2 SAFETY PRECAUTIONS

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the instrument.

1.3 CAUTION AND WARNING STATEMENTS

CAUTION: Used to indicate correct operating or maintenance procedures to prevent damage to or destruction of the equipment or other property.

WARNING: Calls attention to a potential danger that requires correct procedures or practices to prevent personal injury.

1.4 SYMBOLS

Caution (refer to accompanying documents)

Earth

Static sensitive components. One symbol on a PCB means valid for the complete PCB (black/yellow).

1.5 IMPAIRED SAFETY

Whenever it is likely that safety has been impaired, the instrument must be turned off and disconnected from line power. The matter should then be referred to qualified technicians. Safety is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

1.6 GENERAL SAFETY INFORMATION

WARNING: Removing the instrument covers or removing parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.

The instrument shall be disconnected from all voltage sources before it is opened.

Capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

WARNING: Any interruption of the protective ground conductor inside or outside the instrument, or disconnection of the protective ground terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

Components which are important for the safety of the instrument may only be replaced by components obtained through your local FLUKE/PHILIPS organization. (See also section 8).

After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in section 8 must be performed.

2 GENERAL INFORMATION

2.1 CHARACTERISTICS

2.1.1 Performance Characteristics

- PHILIPS guarantees the properties expressed in numerical values with stated tolerance. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.
- These characteristics are valid after the instrument has warmed up for 30 minutes (reference temperature 25 °C).
- For definitions of terms, reference is made to IEC Publication 351-1.

2.1.2 Environmental characteristics

The environmental data mentioned in this manual are based on the results of the manufacturers verification procedures.

Details on these procedures and failure criteria are supplied on request by the FLUKE/PHILIPS organization in your country, or by PHILIPS, INDUSTRIAL ELECTRONICS DIVISION, EINDHOVEN, THE NETHERLANDS.

Environmental aspects: meets requirements of MIL-T 28800D (type III, class 5, style E)

Ambient temperature:

reference temperature : 23 °C ± 2 °C (for performance test + calibration)

Temperature in °C		**Relative Humidity in %**	
Nonoperating[1)]	Operating[2)]	Nonoperating[1)]	Operating[2)]
-40 ... 71 [3)]	0 ... 30	95 ± 5	95 ± 5
	31 ... 40	95 ± 5	75 ± 5
	41 ... 50	95 ± 5	45 ± 5

1) Non-operating limits relate to absorption and corrosion effects.
2) Operating limits relate to actual operating conditions.
3) For the LCD the range is from -20 ... 71.

Altitude
Nonoperating : 4500 m (15000 ft)
Operating : 3050 m (10000 ft)

2.1.3 Mechanical requirements

Vibration, Sinusoidal
Frequency : 5 ... 55 Hz
Resonance search : 15 minutes per axis Cycling:15 minutes per axis
Resonance dwell : 10 minutes per axis
Gravity level at max. frequency 2g m/s^2 at 55 Hz

Shock, Functional

Peak acceleration	:	20g m/s^2
Amount of shocks	:	18, 3 in each direction (x, y and z)
Shock waveform	:	half sine wave
Duration	:	11 ms

Bounce, Loose Cargo
Bench Handling
Shock, High impact : conform to MIL-T 28800D

2.1.4 Instrument performance

Overtemperature (of the power modules)

Protection	:	90 °C ± 5 °C
Release at	:	60 °C ± 5 °C

Isolation : output terminals may not be more than 240 V from ground (output voltage included)

Display Update Rate (measured results)

normal mode	:	4x/s

Load Cross Regulation : negligible for voltage and current

2.1.4.1 Output channel 30V/10A/60W performance

Output Ranges (after 30 minutes warm-up)

Voltage	:	0 ... 30 V
Current	:	0 ... 10 A (min. setting 1 lsb)
Overvoltage	:	2 ... 32 V
Power	:	max. 60 W

Output Accuracy (at calibration temperature)

Voltage	:	± (0.04 % of setting + 10 Mv)
Current	:	± (0.1 % of setting + 5 mA)
Overvoltage	:	± (0.5 % of setting + 15 mV)

Output Temperature Coefficient (after 30 min. warm-up)

Voltage	:	(0.016 % of setting + 2 mV)/K
Current	:	(0.05 % of setting + 2 mA)/K

Long Term Drift (after 30 min. warm-up + 8 hours)

Output voltage	:	0.04 % of setting + 5 mV
Output current	:	0.05 % of setting + 10 mA

Programming Resolutions

Voltage	:	12 bits = 7.5 mV/lsb
Current	:	8 bits = 40 mA/lsb
Overvoltage	:	8 bits = 120 mV/lsb

Source Effect (for any line voltage change within rating)

Voltage	:	± (0.01 % of setting + 2 mV)
Current	:	± (0.02 % of setting + 2 mA)

Load Effect (for a load change equal at nominal rating)
Constant voltage : ± (0.01 % of setting + 5 mV)
(nominal current rating at set voltage)
Constant current : ± (0.02 % of setting + 5 mA)
(nominal voltage rating at set current)

Output Noise (PARD):
Constant voltage
p-p DC ... 30 Mhz : 30 mV
rms : 3 mV

Constant current
rms : 10 mA
switching frequency : ± 20 KHz

Readback Accuracies:
Voltage accuracy : ± (0.05 % of setting + 25 mV)
Current accuracy : ± (0.1 % of setting + 30 mA)

Measuring Resolution:
Voltage : 12 bits
Current : 12 bits

Resolution to Interface:
Voltage : 7.5 mV
Current : 2.5 mA

Resolution to Display:
Voltage : 10 mV
Current : 10 mA

Reverse Voltage : maximum current 10 A

Remote Sense Capability : > 0.25 V voltage drop/wire

Note: At open sense connections, the output voltage will not be more than 3 V above the programmed value.

Dynamic Operation : (load variation I of 1 A between 1 and 10 A)

Settling band : ± 50 mV
dI/dt : < 1 A/ µs
Overshoot : < 150 mV
Recovery time : < 1 ms

Programming Response Times:
Settling band : 50 mV
Up (0 .. 30 V at 2 A) : < 100 ms
Up (0 .. 30 V no load) : < 50 ms
Down (30 ..1 V at 2 A) : < 100 ms
Down (30 ..1 V no load) : < 250 ms

Reprogramming Delay : 50 ms ... 60 s (resolution of 1 ms)

2.1.4.2 Output channel 60V/5A/60W performance

Output Ranges: (after 30 minutes warm-up)

Voltage	:	0 ... 60 V
Current	:	0 ... 5 A (min. setting 1 lsb)
Overvoltage	:	2 ... 62 V
Power	:	max. 60 W

Output Accuracy: (at calibration temperature)

Voltage	:	± (0.04 % of setting + 20 mV)
Current	:	± (0.1 % of setting + 25 mA)
Overvoltage	:	± (0.5 % of setting + 250 mV)

Output Temperature Coefficient: (after 30 min. warm-up)

Voltage	:	(0.016 % of setting + 2 mV)/K
Current	:	(0.05 % of setting + 2 mA)/K

Long Term Drift: (after 30 min. warm-up + 8 hours)

Output voltage	:	0.04 % of setting + 5 mV
Output current	:	0.05 % of setting + 10 mA

Programming Resolutions:

Voltage	:	12 bits = 15 mV/lsb
Current	:	8 bits = 20 mA/lsb
Overvoltage	:	8 bits = 240 mV/lsb

Source Effect (for any line voltage change within rating)

Voltage	:	± (0.01 % of setting + 2 mV)
Current	:	± (0.02 % of setting + 2 mA)

Load Effect (for a load change equal at nominal rating)

Constant voltage : ± (0.01 % of setting + 5 mV)
(for a load change equal to the nominal current rating at set voltage)
Constant current : ± (0.02 % of setting + 5 mA)
(for a load change equal to the nominal voltage rating at set current)

Load Cross Regulation : negligible, for both voltage and current

Output Noise (PARD):

Constant voltage

p-p DC ... 30 Mhz	:	60 mV
rms	:	6 mV

Constant current

rms	:	10 mA
switching frequency	:	20 KHz approx.

Readback Accuracies:

Voltage accuracy	:	± (0.05 % of setting + 50 mV)
Current accuracy	:	± (0.1 % of setting + 15 mA)

Measuring Resolution:

Voltage	:	12 bits
Current	:	12 bits

Resolution to Interface:

Voltage	:	15 mV
Current	:	1.25 mA

Resolution to Display:

Voltage	:	10 mV
Current	:	10 mA

Reverse Voltage : maximum current 5 A

Remote Sense Capability : > 0.25 V voltage drop/wire

Note: At open sense connections, the output voltage will not be more than 3 V above the programmed value.

Dynamic Operation : (load variation I of 0.5 A between 0.5 and 5 A)

Settling band	:	± 50 mV
dI/dt	:	< 0.5 A/µs
Overshoot	:	< 150 mV
Recovery time	:	< 2 ms

Programming Response Times:

Settling band	:	50 mV
Up (0 .. 60 V at 1 A)	:	< 200 ms
Up (0 .. 60 V no load)	:	< 100 ms
Down (60 ..1 V at 2 A)	:	< 200 ms
Down (60 ..1 V no load)	:	< 500 ms
Reprogramming delay	:	100 ms ... 60 s (resolution of 1 ms)

2.1.4.3 Output channel 60V/10A/120W performance

Output Ranges: (after 30 minutes warm-up)

Voltage	:	0 ... 60 V
Current	:	0 ... 10 A (min. setting 1 lsb)
Overvoltage	:	2 ... 62 V
Power	:	max. 120 W

Output Accuracy: (at calibration temperature)

Voltage	:	± (0.04 % of setting + 20 mV)
Current	:	± (0.1 % of setting + 25 mA)
Overvoltage	:	± (0.5 % of setting + 250 mV)

Output Temperature Coefficient: (after 30 min. warm-up)

Voltage	:	(0.016 % of setting + 2 mV)/K
Current	:	(0.05 % of setting + 2 mA)/K

Long Term Drift: (after 30 min. warm-up + 8 hours)

Output voltage	:	0.04 % of setting + 5 mV
Output current	:	0.05 % of setting + 10 mA

Programming Resolutions:

Voltage	:	12 bits = 15 mV/lsb
Current	:	8 bits = 20 mA/lsb
Overvoltage	:	8 bits = 240 mV/lsb

Source Effect (for any line voltage change within rating)
Voltage : ± (0.01 % of setting + 2 mV)
Current : ± (0.02 % of setting + 2 mA)

Load Effect (for a load change equal at nominal rating)
Constant voltage : ± (0.01 % of setting + 5 mV)
(for a load change equal to the nominal current rating at set voltage)
Constant current : ± (0.02 % of setting + 5 mA)
(for a load change equal to the nominal voltage rating at set current)

Load Cross Regulation : negligible, for both voltage and current

Output Noise (PARD):
Constant voltage
p-p DC ... 30 Mhz : 60 mV
rms : 6 mV

Constant current
rms : 10 mA
switching frequency : 20 KHz approx.

Readback Accuracies:
Voltage accuracy : ± (0.06 % of setting + 30 mV)
Current accuracy : ± (0.2 % of setting + 50 mA)

Measuring Resolution:
Voltage : 12 bits
Current : 12 bits

Resolution to Interface:
Voltage : 15 mV
Current : 2.5 mA

Resolution to Display:
Voltage : 10 mV
Current : 10 mA

Reverse Voltage : maximum current 10 A

Remote Sense Capability : > 0.25 V voltage drop/wire

Note: At open sense connections, the output voltage will not be more than 3 V above the programmed value.

Dynamic Operation: (load variation I of 1 A between 1 A and 10 A)
Settling band : ± 50 mV
dI/dt : < 1 A/µs
Overshoot : < 150 mV
Recovery time : < 1 ms

Programming Response Times:
Settling band : 50 mV
Up (0 .. 60 V at 2 A) : < 200 ms
Up (0 .. 60 V no load) : < 100 ms
Down (60 ..1 V at 2 A) : < 200 ms
Down (60 ..1 V no load) : < 500 ms

Reprogramming Delay : 100 ms ... 60 s (resolution of 1 ms)

2.1.5 Safety characteristics

This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments. The present Service Manual contains information and WARNING or CAUTION statements, which must be followed by the user to ensure safe operation and to keep the instrument in a safe condition.

safety:
- meets requirements of IEC 348, UL 1244, and VDE 0411
- approved according to CSA 22.2 nr. 231
- the power cord meets the requirements of:
  - VDE 0411 if shipped with universal European power plug
  - UL 1244/CSA 22.2 if shipped with North American power plug

Protective circuitry within the power supply limits or turns off an output channel in the event of an abnormal condition. The activated protection feature can be observed on the front panel display area. You can also read back the status of the power supply via the GPIB.
The following protection features have been implemented:

OVERVOLTAGE
Disables the output channel by reducing the output to zero volts and zero amperes, if one of the following conditions is present:
- the output voltage exceeds the programmed overvoltage
- the voltage from the + (or -) output terminal to the + (or -) sense terminal exceeds 1.5 volts (only in remote sensing)

When an overvoltage occurs, the text OVERVOLTAGE appears on the display and the OV status bit is set for that output channel.

OVERCURRENT
Disables the output channel by reducing the output to zero volts and zero amperes if the overcurrent protection (OCP) has been enabled and the output current exceeds the maximum current level. In this case the word OVERCURRENT appears on the display and the OC status bit is set for that output channel.

UNREGULATED OUTPUT
The power supply informs the user when an output regulation is not guaranteed. In this case the UNR status bit is set for the unregulated output channel.

OVERTEMPERATURE
Disables the output channel, which has reached an unsafe internal operating temperature, by reducing the output to zero volts and zero amperes. This can be caused by:
- an excessively high ambient temperature
- a blocked or defective fan
- inadequate air circulation, because of insufficient side space

Refer to the protection and release temperature in table A.1.1.1. The overtemperature protection is activated when the overtemperature is exceeded. The overtemperature protection will be released when the temperature is lower than the release temperature and if the protection circuitry is reset.

FAULT
The annunciator above the text FLT is displayed if the output channel is in a status event that has been unmasked so that it will be reported. The following power supply status events have been defined:
- CP= coupled parameters have been applied
- UNR = output is unregulated
- FL= output channel is in overtemperature or sense break
- OC= output channel is in overcurrent
- OV= output channel is in overvoltage
- CC= output channel is in constant current mode
- CV= output channel is in constant voltage mode

2.1.6 Dimensions and Weight

Dimensions:

	single unit	dual/triple unit
Height:	approx. 2U = 86 mm	approx. 2U = 86 mm
Width:	$^1/_2$ x19 inch = 210 mm	19 inch = 420 mm
Depth:	370 mm	370 mm

Weight:

Net weight:	approx 5.5 kg	approx. 9.5kg

2.1.7 Mains Supply Conditions

Power input: 94 V ... 130 V (selectable on the PCB)
190 V .. 255 V (selectable on the PCB)

Power frequency: 47 Hz ... 63 Hz

Fuses 2x:	1 Module	2 Modules	3 Modules
110V:	2.5 AT	4 AT	6.3 AT
220V:	1.25 AT	2.5 AT	3 AT

Power consumption:

	155 VA	275 VA	390 VA

Peak inrush current: 60A (max.)

2.2 INTERFERENCES

2.2.1 Electromagnetic interference

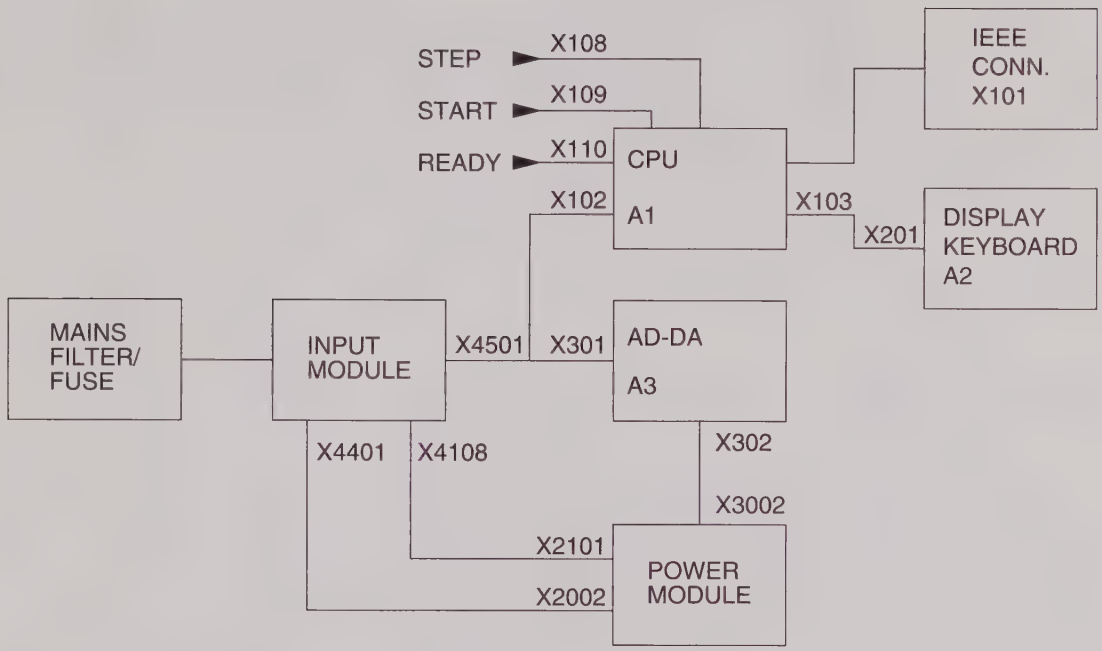
Electromagnetic Compatibility

Emission	:	meets requirements of VDE 0871B + CISPR 11
Susceptibility	:	meets requirements of IEC 801 1-6
Electrostatic Discharge	:	meets requirements of IEC 801-2

2.2.2 Frequency interference

The RFI for an output channel meets the requirements of VDE 0871/A.

3 CIRCUIT DESCRIPTIONS



Block diagram

3.1 DESCRIPTION OF EACH CIRCUIT SECTION

3.1.1 CPU PCB, unit A1

Circuits on this PCB:
* microprocessor system
* watchdog timer
* IEEE interface
* external trigger circuit
* voltage converter for the display
* internal serial bus

A102, PAL
The signal INST determines whether there will be a data fetch ("0") or an external memory read ("1"). The memory read will be an instruction fetch. The PAL combines INST with one of the signals BS0, BS1, or BS2 (Bank Select). This selects (RoM Address) RMA 15, 16, or 17.
IOSEL is combined with A15. When IOSEL is active ("0") the output of the PAL gives IO.
D107 sends the signal TRIG. This signal is combined with signal TRIGEN; the result is the signal TRIGGER. TRIGGER will be read by the microprocessor.

A103, PAL
When READY is "0", the combination of A05 and A06 selects one of the following four circuits:
1- IEEE (IEEE interface selected)
2- DISP (DISPlay selected)
3- KBWR (KeyB Write selected)
4- KBRD (KeyB ReaD selected)

D101, microprocessor

Description of the microprocessor lines:

Port 0 8-bit high impedance input only port. Three pins can be used as digital inputs and/or as analog inputs to the on chip A/D converter. These pin set the Programming Mode.

pin 6 selection of the TEST mode
8 IREADY
9 TRIGGER

Port 1 8-bit quasi-bidirectional I/O port

pin 19 BS0
20 BS1
21 BS2
22 WTRIG-
23 HOLD
30 SYSRDY-
31 FAIL-
32 ground

Port 2 8-bit multifunctional port.

pin 18 TXD
17 RXD
15 IEEE
44 ground
42 ground
39 PWM
33 ground
38 ground

Port 3 8-bit bidirectional I/O ports with open drain outputs. These pins are shared with the multiplexed address/data bus, which has strong internal pull-ups.

60, 59, 58, 57, 56, 55, 54, 53 } AD0-AD7

Port 4 Address lines 8 to 15

52, 51, 50, 49, 48, 47, 46, 45 } A08-A15

PIN	DESCRIPTION
Symbol	Name and Function
Vcc	Power supply voltage (5V)
Vss	Digital circuit ground (0V). There are two Vss pins, both of which must be connected.
VREF	Reference voltage for the A/D converter (5V). VREF is also the supply voltage to the analog portion of the A/D converter and the logic used to read Port 0. Must be connected for A/D and Port 0 to function.
XTAL1	Input of the oscillator inverter and of the internal clock generator.
XTAL2	Output of the oscillator inverter.
CLKOUT	Output of the internal clock generator. The frequency of CLKOUT is 1/2 the oscillator frequency. It has a 50% duty cycle.
RESET	Reset input to the chip Input low for at least 4 state times to reset the chip. The subsequent low-to-high transition resynchronizes CLKOUT and commences a 10-state-time sequence in which the PSW is cleared, a byte read from 2018H loads CCR, and a jump to location 2080His executed. Input high for normal operation. RESET has an internal pull up.
INST	Output high during an external memory read indicates there is an instruction fetch. INST is valid throughout the bus cycle. INST is activated only during external memory accesses and output low for a data fetch.
ALE	Address Latch Enable or Address Valid output, as selected by CCR. Both pin options provide a latch to demultiplex the address from the address/data bus. When the pin is ADV-, it goes inactive high at the end of the bus cycle. ADV- can be used as a chip select for external memory. ALE/ADV- is activated only during external memory accesses.
Rd-	Read signal output to external memory. Rd- is activated only during external memory reads.
WR-/WRL-	Write and Write low output to external memory, as selected by the CCR. WR- will go low for every external write, while WRL- will go low only for external writes where an even byte is being written. WR-/WRL- is activated only during external memory writes.
READY	Ready input to lengthen external memory cycles, for interfacing to slow or dynamic memory, or for bus sharing. If the pin is high, CPU operation continues in a normal manner. If the pin is low prior to the falling edge of CLOCKOUT, the memory controller goes into a wait mode until the next positive transition in CLKOUT occurs with READY high. When the external memory is not being used, READY has no effect. Internal control of the number of wait states inserted into a bus cycle held not ready is available through configuration of CCR.
HSI	Inputs to High Speed Input Unit. Four HSI pins are available: HSI.0, HSI.1, HSI.2, and HSI.3. Two of them (HSI.2 and HSI.3) are shared with the HSO Unit. The HSI pins are also used as the SID in Slave Programming Mode.
HSO	Outputs from High Speed Output Unit. Six HSO pins are available: HSO.0, HSO.1, HSO.2, HSO.3, HSO.4, and HSO.5. Two of them (HSO.4 and HSO.5); are shared with the HSI Unit.

HOLD- Bus Hold input requesting a control of the bus. Enabled by setting WSR.7.

HLDA- Bus Hold acknowledge output indicating release of the bus. Enabled by setting WSR.7.

BREQ- Bus Request output activated when the bus controller has a pending external memory cycle Enabled by setting WSR.7.

D102, counter with oscillator

D102 is used as watchdog. The oscillator constantly oscillates. The frequency of this pulse is divided by the internal divider. When a rising edge is output at pin 3, this will cause a positive and negative reset pulse at the outputs of N101. When the circuit normally functions, the oscillator gets positive pulses from the microprocessor. These pulses reset the oscillator and this prevents the output of the rising edge at pin 3.

D103, latch
D103 is used to latch the lower byte of the address.

D104, latch
D104 will be used for the free run test.

D105, RAM

D106
Integrated circuit for serial communication. It is used for internal communication between the units.

D107,
Integrated circuit for communication via the IEEE interface bus

D108, D109 and D110
Buffer integrated circuits especially for IEEE

D111, NAND gate with open drain
Used for several invert and "AND" functions

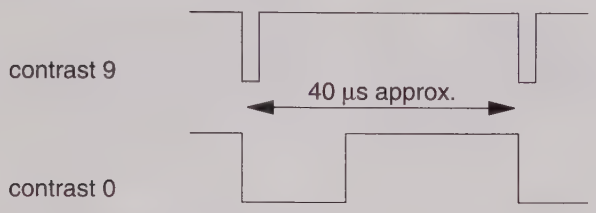
N101,
Integrated circuit used for the positive and negative RESET pulse

T101,
Unit to convert 5 V into VBL+ and VBL-

Test points:
TP101
The ALE (Address Latch Enable) signal

TP102
The WR (WRite) signal

TP103
Contrast:
The signal PWM (TP103) is valid for the contrast of the display.



TP104
+ 5 V power supply

TP106
Ground

3.1.2 DISPLAY KEYBOARD PCB, unit A2

Keyboard
Normally D201 (write function) makes all ROW's "0". Every 40 ms all COLUMNS are scanned via latch D202 (read function) by the microprocessor on the CPU. When no key is pressed, the result is FFH. If the result differs from FFH, then all the ROW's except the first ROW will be made "1". Now the COLUMNS will be read one by one starting at COLUMN 1. After the reading of COLUMN 6, only ROW 2 is made "0" and all COLUMNS will be read. This process continues with ROW 3 etc.

Display
The display consists of:
- LCD controller and driver
- LCD segment driver
- LCD
- The backlight

The LCD controller driver has its own oscillator. The frequency is 300 Khz approximately. The information for the display will be send to the controller driver. This IC sends the data to the segment driver.

3.1.3 AD-DA PCB, unit A3

Function of the AD-DA PCB

- You can select the settings of the PPS via the keyboard or the IEEE bus. The CPU sends these settings to the AD-DA PCB. This data will be sent via a galvanic separation. The AD-DA converts the data into analog signals that can command the power module(s).
- The analog Read Back Voltage (RBV) and Read Back Current (RBC) are converted into digital data and sent to the CPU PCB.
- The device-dependent settings sent by the CPU are stored in the EEPROM.

Circuits on this PCB

- microprocessor system
- EEPROM to store the system information
- galvanic separation
- 3 DAC circuits
- 1 ADC circuit

A301, EPROM

On the AD-DA PCB, a 32K x 8 EPROM is used.

H301, H302

These are the two IC's for the galvanic separation between the CPU and the AD-DA PCB, one for each direction.

D301, D^2B bus IC

The signal is symmetrical around 2.5 V. The protocol is 9 bits. The ninth bit will only be used for the address.

D302, EEPROM

The EEPROM is used to store the system information. The communication is done by the I^2C bus.

D304, latch

The IC is used to read the preselection spots.

D305, microprocessor

The microprocessor has four bidirectional I/O ports.

Port 0 Port 0 is used as a bidirectional I/O port for the data bus and the low order address lines. The low order addresses are latched into D306 by the signal ALE (Address Latch Enable)

Port 1 Port 1 is used for several read functions

VCOMP	comparator output for the SAR function of the ADC to get RBV
ICOMP	comparator output for the SAR function of the ADC to get RBC
PAR-	the signal PAR (coupled PARameters) the power module
PE-	the signal PE (Power Enable) of the power module
FLT	the signal FLT (FauLT) of the power module
CM-	the signal CM (Current Mode) of the power module
VM-	the signal VM (Voltage Mode) of the power module
OVP	the signal OVP (Over Voltage Protection) of the power module

Port 2 Port 2 is used for the high order address lines.

Port 3

RXD	receive data line from CPU PCB
TXD	transmit data line to CPU PCB
WDRES-	WatchDog RESet. This is the output of a counter. The counter will be reset by the main loop. So when the microprocessor normally functions, there will be a reset of the counter before there will be output. The result is no output pulses during normal functioning.
RUN	to control LED H303
SCL	clock line IIC bus
SDA	data line IIC bus
WR-	] ⇒STAB-
RD-	

D306, latch

The IC is used to store the low significant bits of the address. The address is stored during the high period of ALE (Address Latch Enable).

D307, decoder

The IC is used to:

- Select the write mode of DAC N302 (WDAC1-)
- Select the write mode of DAC N303 (WDAC0-)
- Make line LDAC of N303 active to load new digital data into the DAC
- To read the spots J302-306 into latch D304
- VTRIG TP303
- ITRIG TP302

D308, NAND gate

The IC is used for several NAND and invert functions.

N301

N301 outputs a positive and negative RESET pulse after the receipt of WDRES-.

N302, 8 bit DAC

There are two DAC's in the housing. The selection is made by address line A08 (DACA-, DACB). The output is a current. The current is converted into a voltage by N304. DAC A is used to set the Over Voltage Protection (OVP) and DAC B to set the output current. These two signals are going to the selected power module.

NOTE: In the future this DAC will be replaced by the same type as N303. Also the functioning will be the same as N303. This requires that the PROM must be replaced too.

N303, 12 bit DAC

There are two DAC's in the housing. The selection is made by address line A08 (DACA-, DACB). For a 12-bit DAC, it is necessary to send the data in two bytes.
Address line A09 selects the low or high significant part of the data.
The output is a current. The current is converted into a voltage by N305.
DAC A is used to set the output voltage.
DAC B is used to make a DAC. For the conversion the Successive Approximation Register principle is used. This is done in combination with the microprocessor and comparator N308. The SAR function is done by the microprocessor. The ADC function is used for the Read Back Voltage (RBV) and Read Back Current (RBC).
RESET resets both outputs to zero.

N306, operational amplifier

Opa N306 is used the invert Vref to -Vref.

N307, comparator

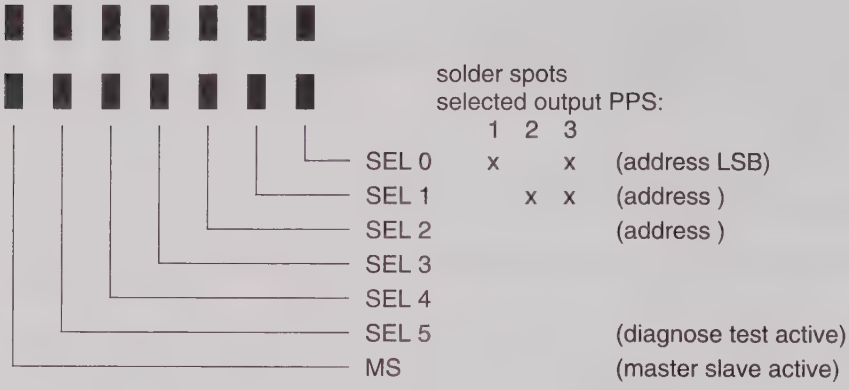
N307 is used to compare the DAC output Vadc to the RBV. At first the RBV is buffered by N309. The output is used for SAR function of the microprocessor.

N308, comparator

N308 is used to compare the DAC output Vadc to the RBC. At first the RBC is buffered by N309. The output is used for SAR function of the microprocessor.

Replacing the AD-DA PCB

The PCB must be selected for the output where it should function. This is done by interconnection of one of the solder spots.



The AD-DA unit delivered by Consumer Service is called unit A3. The unit name in the PPS depends on the output it is used for.

Output	Unit name	Family name PPS
1	A31	PM281*/**
2	A32	PM2812/**, PM2813/**
3	A33	PM2813/**

The system configuration of the PPS is stored in the EEPROM. If this data is lost, the PPS must be configured. The configuration must be done via the IEEE bus.

Command: DIAGnostics:CONFigure p0,p1,..,p13

Example of the configuration:
:INST:NSEL 1 to select the output to be configured.
:DIAG:CONF p1,p2,....,p13

Data description to configure the PPS.

Data description for the configuration of power modules.

The parameters p1 ... p13:

PAR.	DESCRIPTION	30V/10A	60V/5A	60V/10A
p1	CONFPASSWORD	12345	12345	12345
p2	U min (V)	0	0	0
p3	U max (V)	30	60	60
p4	I min (A)	0	0	0
p5	I max (A)	10	5	10
p6	OV min (V)	2	2	2
p7	OV max (V)	32	62	62
p8	DLY def (ms)	50	100	100
p9	identity 1 *)	abcd	abcd	abcd
p10	identity 2 *)	qrst	qrst	qrst
p11	P max (W)	60	60	120
p12	V-I set resol.	3080	3080	3080
p13	OV-OUT resol.	2060	2060	2060

*) see table next page

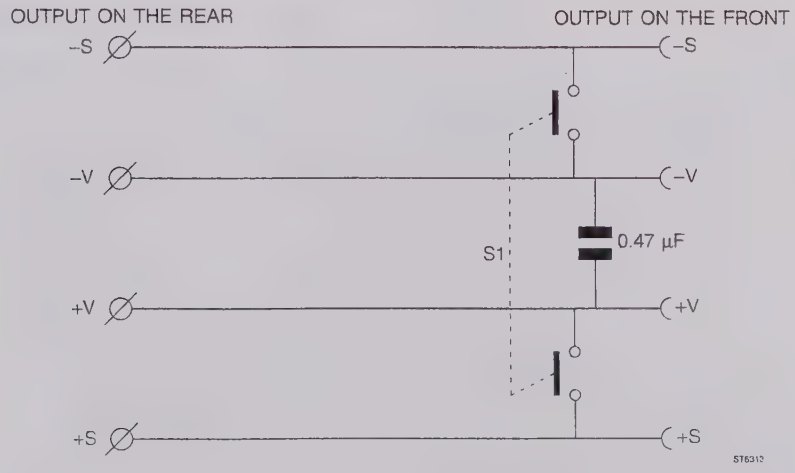
Identity 1 specifies the numerical part of the main type number.
Identity 2 specifies: qrst

- q — number of output channels
- r — not used
- s — revision number
- t — sub type number

TYPENR.	OUTPUT 1	OUTPUT 2	OUTPUT 3	IDENTITY 1,2	
				abcd	qrst
PM2811/0	30V/10A	x	x	2811 ,	0101
PM2811/1	60V/5A	x	x	2811 ,	1101
PM2812/0	30V/10A	30V/10A	x	2812 ,	0102
PM2812/1	60V/5A	60V/5A	x	2812 ,	1102
PM2812/2	30V/10A	60V/5A	x	2812 ,	2102
PM2812/3	60V/10A	30V/10A	x	2812 ,	3102
PM2812/4	60V/5A	60V/10A	x	2812 ,	4102
PM2813/0	30V/10A	30V/10A	30V/10A	2813 ,	0103
PM2813/1	60V/5A	60V/5A	60V/5A	2813 ,	1103

The configuration takes some time. When you press the "LCL" (return to local) key immediately after sending the configuration command, then the disappearing of the indication REM on the display means the end of the configuration.

3.1.4 Output on the front panel



NOTE: When the sense terminals are connected to the output terminals by the sense switch, it is not permitted to use the sense terminals as the output terminals. If this is done, a high output current will damage the sense switch.

3.1.5 Input module

General :
The input module can only be repaired in the factory. On this PCB the line power voltage must be set to the correct range.

3.1.5.1 Setting of the line power voltage (also see the interconnection diagrams).

The mains voltage is separated into two ranges:
a 94 V ... 130 V
b 190 V ... 255 V

Selecting range **a**:
The blue (bl) wire of cable loom DB1 must be connected to X4106. X4102 is not connected.

Selecting range **b**:
The blue (bl) wire of cable loom DB1 must be connected to X4102. X4106 is not connected.

4 PERFORMANCE VERIFICATION PROCEDURES

4.1 GENERAL INFORMATION

The following information provides the complete checking procedure for the local operation of the instrument. Before any check, the instrument must attain its normal operating temperature.

- The warm up time is 30 minutes.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument specifications. (Refer to section 2 for specifications.)
- Tolerances given are for the instrument under test and do not include test equipment errors.

The performance verification is intended to:

- Verify the instrument characteristics.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instruments.
- Check the necessity of recalibration after the specified recalibration intervals.

NOTE: Tolerances given are for the instrument under test and do not include test equipment error.

4.2 RECOMMENDED TEST EQUIPMENT

- DMM PM2525 or equivalent to measure the output current.
- DMM PM2534 or equivalent to measure the output voltage.
- A load of 60 Ω that can handle at least 120 W
- A load of 30 Ω that can handle at least 120 W
- A load of 15 Ω that can handle at least 60 W
- PC equipped with a PM2201 to test the interface

OUTPUT VOLTAGE/CURRENT

This procedure should be done for all outputs of the unit. This means instead of output 1, you should select output 2 or output 3 depending on the output that should be checked.

- Verify the line power voltage is within the (factory) selected range. 110 V gives the range 94 V... 130 V and 230 V gives the range 190 V... 255 V (see type plate).
- Connect the Programmable Power Supply (PPS) to the line power
- Connect the PM2534 to the output socket of the power unit under test. The pole of the DMM to S and -V and the + pole to + S and + V.
- Switch on the PPS. The power switch is at the rear beside the power connector.
- Program 5 output voltages:
  - Set the overvoltage protection to the max. value.
    + Press the "OVP" key; the display will read: OVSET ...V.
    + Press the "6", "2", and "ENTER" keys for a 60 V module, or press the "3", "2", and "ENTER" keys for a 30 V module.
  - Select Output 1.
    + Press the "SELECT" key till the display reads "1" on the left hand side.
  - Set the output voltage to 10 V.
    + Press the "V" key; the display will read: VSET ...V.
    + Press the "1", "0", and "ENTER" keys.
  - Set the output current to 1 A.
    + Press the "I" key; the display will read: ISET ...A.
    + Press the "1" and "ENTER" keys.
  - Store these settings into memory location 1.
    + Press the "STORE", "1", and "ENTER" keys.

- Set the output voltage to 15 V.
  + Press the "V" key; the display will read: VSET ...V.
  + Press the "1", "5", and "ENTER" keys.
- Set the output current to 1 A.
  + Press the "I" key; the display will read: ISET ...A.
  + Press the "1" and "ENTER" keys.
- Store these settings into memory location 2.
  + Press the "STORE", "2", and "ENTER" keys.

- Set the output voltage to 20 V.
  + Press the "V" key; the display will read: VSET ...V.
  + Press the "2", "0", and "ENTER" keys.
- Set the output current to 1 A.
  + Press the "I" key; the display will read: ISET ...A.
  + Press the "1", and "ENTER" keys.
- Store these settings into memory location 3.
  + Press the "STORE", "3", and "ENTER" keys.

- Set the output voltage to 25 V.
  + Press the "V" key; the display will read: VSET ...V.
  + Press the "2", "5", and "ENTER" keys.
- Set the output current to 1 A.
  + Press the "I" key; the display will read: ISET ...A.
  + Press the "4" and "ENTER" keys.
- Store these settings into memory location 4.
  + Press the "STORE", "4", and "ENTER" keys.

- Set the output voltage to 30 V.
  + Press the "V" key; the display will read: VSET ...V.
  + Press the "3", "0", and "ENTER" keys.
- Set the output current to 1 A.
  + Press the "I" key; the display will read: ISET ...A.
  + Press the "1", and "ENTER" keys.
- Store these settings into memory location 5.
  + Press keys "STORE", "5", and "ENTER".

- Measure the programmed output voltages.
  - If the display reads: STANDBY, press the "OPR/STBY" key.
  - If the display reads: DISABLED (only in PM2812 and PM2813), press the "ENABLE/DISABLED" key.
  - Press the "RECALL", "1", and "ENTER" keys.
    The DISPLAY should indicate: 10 V approximately.
    The DMM should indicate: The reading of the DISPLAY after pressing the "V" key ± 14 mV for the 30 V module and ± 24 mV for the 60 V module.

  - Press the "RECALL", "2", and "ENTER" keys .
    The DISPLAY should indicate: 15 V approximately.
    The DMM should indicate: The reading of the DISPLAY after pressing the "V" key ± 16 mV for the 30 V module and ± 26 mV for the 60 V module.

  - Press the "RECALL", "3", and "ENTER" keys.
    The DISPLAY should indicate: 20 V approximately.
    The DMM should indicate: The reading of the DISPLAY after pressing the "V" key ± 18 mV for the 30 V module and ± 28 mV for the 60 V module.

- Press the "RECALL", "4", and "ENTER" keys.
  The DISPLAY should indicate: 25 V approximately.
  The DMM should indicate: The reading of the DISPLAY after pressing the "V" key ± 20 mV for the 30 V module and ± 30 mV for the 60 V module.

- Press the "RECALL", "5", and "ENTER" keys.
  The DISPLAY should indicate: 30 V approximately.
  The DMM should indicate: The reading of the DISPLAY after pressing the "V" key ± 22 mV for the 30 V module and ± 32 mV for the 60 V module.

- Check **manual** STEP function.
  - Press the "STEP", "1", and "ENTER" keys.
  - The display will read the settings of memory 1: 10 V approximately.
  - Press the "STEP" key.
  - The display will read the settings of memory 2: 15 V approximately.
  - Press the "STEP" key.
  - The display will read the settings of memory 2: 20 V approximately.
  - Press the "STEP" key.
  - The display will read the settings of memory 2: 25 V approximately.
  - Press the "STEP" key.
  - The display will read the settings of memory 2: 30 V approximately.

- Check **auto** STEP mode.
  - Press the "AUX" key till the display reads: STEP MENU
  - Press the "ENTER"key.
  - Press the "ON" key when the display reads: AUTO STEP **OFF.**
  - Press the "AUX" key; the display will read: TIME INTerval .. s.
  - If the time interval <> 2.0 s, then press the "2", and "ENTER" keys.
  - Press the "AUX" key; the display will read: CONTINUOUS ..
  - Press the "ON" key; the display will read: CONTINUOUS ON.
  - Press the "AUX" key; the display will read: START AT ..
  - Press the "1" and "ENTER" keys when the reading <> 1.
  - Press the "AUX" key; the display will read: AT ..
  - Press the "5" and "ENTER" keys when the reading <> 5.
  - Press the "ENTER" key to leave the step menu.
  - Press the "STEP", "1" and "ENTER" keys. After this the PPS will scan the memory locations 1 to 5 and shows the earlier programmed voltages.

- Check overvoltage protection.
  - Press the "V" key
  - Press the "1", "2", and "ENTER" keys (set V to 12 V)
  - Press the "OVP" key.
  - Press the "1", "0", and "ENTER" keys (set overvoltage to 10 V). The display will read: OVERVOLTAGE
  - To leave the OVERVOLTAGE situation:
    + Press the "OVP" key; the display will read: OVSET 10V.
    + Press the "6", "2", and "ENTER" keys for a 60 V module or the "3", "2", and "ENTER" keys for a 30 V module.
    + Press the "RESET" key.

- Check overcurrent protection.
  - If the display reads STANDBY, press the "OPR/STBY" key
  - If the display reads DISABLED (only for PM2812 and PM2813), press the "ENABLE/DISABLE" key. Now output 1 is disabled.
  - Press the "OPR/STBY" key; the display will read STANDBY
  - Press the "V" key.
  - Press the "1", "2", and "ENTER" keys (set V to 12 V).

- Press the "I" key; the display will read: ISET ...A.
- Press the ".", "5", and "ENTER" keys (set I to 0.5 A).
- Short circuit the output terminals.
- Press the "OPR/STBY" key. The annunciator will point to "CC" or "OCP EN". If it points to "CC", press the "OCP EN/ OCP DIS" key. The display will read: OVERCURRENT.
- To leave the overcurrent situation:
  + Press the "OCP EN/OCP DIS" key.
  + Press the "RESET" key.

- Check output current.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY. Now the output is disabled.
  - Press the "V" key.
  - Press the "1", "2", and "ENTER" keys (set V to 12 V).
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "5" and "ENTER" keys (set I to 5 A).
  - Connect the DMM as a current meter to the output terminals.
  - Press the "OPR/STBY" key. The annunciator will show "CC" and the DMM should read: The reading of the DISPLAY after pressing the "I" key ± 55 mA for the 10 A modules and ± 30 mA for the 5 A modules.
  - Press key "OPR/STBY". The display should read: STANDBY.

- Check "AUX"key.
  - Press the "AUX" key; the display should read: STEP MENU.
    + Sub menu of STEP MENU.
      * Press the "ENTER" key; the display should read: AUTO STEP ON/OFF.
      * Press the "AUX" key; the display should read: TIME INT (interval between steps) .. s.
      * Press the "AUX" key; the display should read: CONTINUOUS (step) ON/OFF.
      * Press the "AUX" key; the display should read: START AT ..
      * Press the "AUX" key; the display should read: AT ..
      * Press the "AUX" key; the display should read: STEP MENU. This is the end of the sub menu.
  - Press the "AUX" key; the display should read: COUPLE PARA (coupled parameters) ON/OFF.
  - Press the "AUX" key; the display should read: COUPLE PROT (coupled protection only for PM2812 and PM2813) ON/OFF.
  - Press the "AUX" key; the display should read: STBY AT PON (stand by at power on) ON/OFF.
  - Press the "AUX" key; the display should read: CONTRAST .
  - Press the "AUX" key; the display should read: KEY LOCK ON/OFF.
  - Press the "AUX" key; the display should read: ADDRESS ...
  - Press the "AUX" key; the display should read: PM28.. S.. .:..
  - Press the "AUX" key; the display should read: CAL CODE
  - Press the "ENTER" key to terminate the AUX menu.

- Check "DISP"key.
  - Press the "DISP" key; the display should read: FAULT .
  - Press the "DISP" key; the display should read: FAULT-CP (coupled parameters) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-UNR (unregulated output) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-FL (failure) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-OC (overcurrent) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-OV (overvoltage) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-CC (constant current) ON/OFF.
  - Press the "DISP" key; the display should read: FAULT-CV (constant voltage) ON/OFF.
  - Press the "DISP" key; the display should read: NO FAULT.
  - Press the "ENTER" key to terminate the DISP function.

- Check "DELAY" key.
  - If the display reads STANDBY, press key "OPR/STBY".
  - If the display reads DISABLED, (only for PM2812 and PM2813) press the "ENABLE/DISABLE" key. Now the indicated output is enabled.
  - Press the "OPR/STBY" key; the display will read STANDBY.
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "1", "0", and "ENTER" keys (set V to 10 V).
  - Press the "I" key; the display will read: ISET .. A.
  - Press the "5" and "ENTER" keys (set I to 5 A).
  - Press the "OCP EN/OCP DIS" key; the annunciator will point to OCP EN.
  - Press the "DELAY" key ; the display will read: DELAY .. s.
  - Press the "2", "0", and "ENTER" keys (set the delay to 20 s).
  - Short circuit the output terminals.
  - Press the "OPR/STBY" key; the display will read: 1 ...V. ...I. After **20 s** the annunciators will also point to FLT (if unmask is set to 255). The display will show: OVERCURRENT.
  - To leave the overcurrent situation:
    + Press the "OCP EN/OCP DIS" key.
    + Press the "RESET" key.

- Check "UNMASK" key.
  - Press the "UNMASK" key; the display should read: UNMASK ..
  - Press the "2", "5", "5", and "ENTER" keys (set mask for all functions).
  - Press the "UNMASK" key; the display should read: UNMASK 255.
  - Press the "UNMASK" key; the display should read: UNMASK-DEN ON.
  - Press the "UNMASK" key; the display should read: UNMASK-CP ON.
  - Press the "UNMASK" key; the display should read: UNMASK-UNR ON.
  - Press the "UNMASK" key; the display should read: UNMASK-FL ON.
  - Press the "UNMASK" key; the display should read: UNMASK-OC ON.
  - Press the "UNMASK" key; the display should read: UNMASK-OV ON.
  - Press the "UNMASK" key; the display should read: UNMASK-CC ON.
  - Press the "UNMASK" key; the display should read: UNMASK-CV ON.
  - Press the "ENTER" key; the UNMASK routine will be terminated.

- Check "- V +" key.
  - Press the "OPR/STBY" key; when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key; (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "+" side of the "- V +"; the voltage your display reads should slowly increase.
  - Press the "-" side of the "- V +" key; the voltage your display reads should slowly decrease.

- Check "- I +" key.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "V" key; the display will read: VSET .. V
  - Press the "1", "0", and "ENTER" keys (set the output voltage to 10 V).
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "2", and "ENTER" keys (set I to 2 A).
  - Short circuit the output terminals of the output indicated on the left side of the display.
  - Press the "OPR/STBY" key to enable the output.
  - Press the "+" side of the "- I +" key; the voltage your display reads should slowly increase.
  - Press the "-" side of the "- I +" key; the voltage your display reads should slowly decrease.

- Check load effect for a 60V/5A unit in the constant voltage mode.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "1", and "ENTER" keys (set I to 1 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "5", "5", and "ENTER" keys (set the output voltage to 55 V).
  - Connect the DMM to the output to measure the output voltage.
  - Press the "OPR/STBY" key; the reading STANDBY will disappear from the display.
  - Read the output voltage on the DMM.
  - Press the "OPR/STBY" key; the display will read STANDBY.
  - Connect the load resistor of 60 Ω to the output.
  - Press the "OPR/STBY" key. The annunciator should point to CV. The display should read 55 V approximately.
    The difference between this reading of the DMM and the one when the PPS was unloaded should be less than 10.5 mV.

- Check load effect for a 60V/5A unit in the constant current mode
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "1", and "ENTER" keys (set I to 1 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "6", "0", and "ENTER" keys (set V to 60 V).
  - Connect the DMM as a current meter in series with a resistor of 30 Ω to the output
  - Press the "OPR/STBY" key; the reading STANDBY will disappear from the display; the annunciator will point to CC.
  - Read the output current on the DMM.
  - Press the "OPR/STBY" key; the display reads STANDBY.
  - Short circuit the output of the PPS with the DMM as a current meter.
  - Press the "OPR/STBY" key.
    The display should read 30V 1A approximately and the annunciator should point to CC.The difference between this reading of the DMM and the one where the PPS was loaded with 30 Ω should be less than 5.2 mA.

- Check load effect for a 60V/10A unit and constant voltage mode.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "2", and "ENTER" keys (set I to 2 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "5", "5", and "ENTER" keys (set the output voltage to 55 V).
  - Connect the DMM to the output to measure the output voltage.
  - Press the "OPR/STBY" key; the reading STANDBY will disappear from the display.
  - Read the output voltage on the DMM, the annunciator should point to CV.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Connect the load resistor of 30 Ω to the output
  - Press the "ENABLE/DISABLE" key.
    The display should read 55 V approximately; the annunciator should point to CV.
    The difference between this reading of the DMM and the one the PPS was unloaded should be less than 10.5 mV.

- Check load effect for a 60V/10A unit in the constant current mode.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "2", and "ENTER" keys (set I to 2 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "6", "0", and "ENTER" keys (set V to 60 V).
  - Connect the DMM as a current meter in series with a resistor of 15 Ω to the output.
  - Press the "OPR/STBY" key; the reading STANDBY will disappear from the display; the annunciator should point to CC.
  - Read the output current on the DMM.
  - Press the "OPR/STBY" key; the display will read STANDBY.
  - Short circuit the output of the PPS with the DMM as a current meter.
  - Press the "OPR/STBY" key.
    The display should read 2A approximately; the annunciator should point to CC.
    The difference between this reading of the DMM and the one where the PPS was loaded with 15 Ω should be less than 5.4 mA.

- Check load effect for a 30V/10A unit and constant voltage mode.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key (only PM2812 and PM2813) when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "2", and "ENTER" keys (set I to 2 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "2", "5", and "ENTER" keys (set the output voltage to 25 V)..Connect the DMM to the output to measure the output voltage.
  - Press the "OPR/STBY" key; the reading STANDBY will disappear from the display; the annunciator should point to CV.
  - Read the output voltage on the DMM.
  - Press the "OPR/STBY" key; the display will read: STANDBY
  - Connect the load resistor of 15 Ω to the output.
  - Press the "OPR/STBY" key.
    The display should read 25 V approximately; the annunciator should point to CV.
    The difference between this reading of the DMM and the one where the PPS was unloaded should be less than 7.5 mV.

- Check load effect for a 30V/10A unit in the constant current mode.
  - Press the "OPR/STBY" key when the display reads: STANDBY.
  - Press the "ENABLE/DISABLE" key when the display reads: DISABLED.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Press the "I" key; the display will read: ISET ...A.
  - Press the "1", and "ENTER" keys (set I to 1 A).
  - Press the "V" key; the display will read: VSET .. V.
  - Press the "3", "0", and "ENTER" keys (set V to 30 V).
  - Connect the DMM as a current meter in series with a resistor of 15 Ω to the output.
  - Press the "OPR/STB" key; the reading STANDBY will disappear from the display; the annunciator should point to CC.
  - Read the output current on the DMM.
  - Press the "OPR/STBY" key; the display will read: STANDBY.
  - Short circuit the output of the PPS with the DMM as a current meter.

- Press the "OPR/STBY" key.
  The display should read 1 A approximately; the annunciator should point to CC.
  The difference between this reading of the DMM and the one where the PPS was loaded with 15 Ω should be less than 5.2 mA.

- Check functioning of the interface
  - Connect the PPS to the PC via the interface
  - Send to the PPS: *IDN?
  - The PPS should send to the PC: PHILIPS,PM281./..,0,V.... At the same time the display should read REM (remote state).
  - Press key "LCL" (return to local). The text REM should disappear from the display.

5 DISASSEMBLING THE INSTRUMENT

5.1 GENERAL INFORMATION

This section provides the disassembly procedures required for the removal of components during repair operations.
All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During disassembly make a careful note of all disconnected leads so that they can be reconnected to their correct terminals when the instrument is reassembled.

CAUTION: Damage may result if:
- The instrument is turned on when a circuit board has been removed.
- A circuit board is removed within one minute after turning off the instrument.

5.2 REMOVING THE COVER

WARNING: Removing the instrument cover or removing parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
To avoid electric shock, turn off line power and remove the power cord before disassembling the instrument.
If adjustment, maintenance, or repair of the disassembled instrument under voltage is necessary, it shall be carried out only by qualified personnel using customary precautions against electric shock. Capacitors inside the instrument may still be charged even after the instrument has been turned off or disconnected from the power supply.

- Remove the two feet on the rear side.
- Remove the two screws on each side of the housing.
- Remove the screw on the rear side of the bottom.
- Remove the cover by sliding it to the rear.

5.3 DISASSEMBLING THE INSTRUMENT

The input module

After removing the cables and the mounting screw, the PCB can be shifted and lifted out of the instrument.

The CPU PCB

After removing the flat cables and the mounting screws of the IEEE connector from the rear panel, the PCB can be shiftedvb and lifted out of the instrument.

The AD-DA PCB

Remove the three screws on the conductor side of the PCB. Remove the cables from the PCB.

The power module

First you must remove the AD-DA PCB.
The power module is mounted to the chassis by the two hexagonal distance pieces of the AD-DA and one screw on the PCB (near the output connector). After removing the screws and the cables, you can remove the power module out of the instrument.

5.4 REASSEMBLING THE INSTRUMENT

Reassemble the instrument by reversing the disassemble procedure.

6 CALIBRATION ADJUSTMENT PROCEDURE

6.1 GENERAL INFORMATION

The following information provides the complete calibration adjustment procedure for the instrument. Because various control functions are interdependent, a certain order of adjustment is necessary. The procedure is, therefore, presented in a sequence which is best suited to this order; cross-reference is made to any circuit which may affect a particular adjustment.
Before any adjustment, the instrument must attain its normal operating temperature.

- Warm-up time under average conditions is 30 minutes.
- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument characteristics unless they are also published in chapter 2.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused low intensity display.
- All controls which are shown without item numbers are located on the outside of the instrument.

WARNING: Removing the instrument cover or removing parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement, or maintenance and repair during which the instrument will be opened.
If any adjustment, maintenance, or repair of the disassembled instrument under voltage is necessary, it shall be carried out only by qualified personnel using customary precautions against electric shock.
Capacitors inside the instrument may still be charged even after the instrument has been disconnected from its power supply.

6.1.1 Recommended equipment for local calibration

- DMM PM2525 or equivalent to measure the output current.
- DMM PM2534 or equivalent to measure the output voltage.

6.1.2 Recommended equipment for remote calibration

- The equipment for local calibration
- PC equipped with a PM2201 to send the commands to calibrate

6.2 CALIBRATION PROCEDURES

6.2.1 Local calibration procedure

General: Calibration is done for one output channel at a time. New calibration data is made active when the calibration session is terminated correctly, in order to perform a complete calibration of your power supply.

WARNING: Because the voltage and current to be measured with the DMM will be used as the reference for the calibration voltage and current, the DMM itself must be calibrated very accurately.

Power failure during calibration:

When a power failure occurs during calibration, there are two possible outcomes:

1- The calibration data was not yet accepted or the overvoltage calibration was not yet completed. This will result in a normal termination of the calibration without any changes in the calibration data. This is because the voltage, current, and overvoltage must be calibrated together.

2- The calibration data was accepted, but saving the new data was not yet completed. If this is the case, the saving of the calibration data will be resumed as soon as the line power returns.

When you press the ENTER key, normal operation is resumed and the STANDBY mode is entered. The display shows:

n STANDBY

This procedure must be followed sequentially.

- To enter the calibration session, press the key AUX during power on of your power supply. After a few seconds the display shows:

  n CODE

- Type your calibration access code, then press the ENTER key. The display shows:

  n CALIBRATE ON

- Select the output channel (n) to be calibrated by pressing the SELECT key a number of times (only applicable for multiple output units).

V1 Connect the DMM to the +V and -V terminal of the output channel to be calibrated. The DMM must be in the voltage range.
First the low calibration voltage point is calibrated. After pressing the ENTER key, the display shows:

n VCAL LOW

V2 By pressing the ENTER key again, the low voltage setting is made active. The display shows:

n VCAL

V3 The low voltage can now be measured with the DMM. Check that the power supply is in the Constant Voltage mode. This is indicated on the display with the annunciator above the text CV. Enter the measured low value with the numeric keys, then press the ENTER key.

- If the output channel is not able to operate in the CV mode, there is another load connected to the output channel, putting it in the CC mode; therefore, disconnect the other load to allow the output channel to enter the CV mode of operation.

- If the entered measured value is out of the expected range, the display will show:

  n VCAL ERROR
  In this case, measure the low voltage with the DMM again, and enter the measured value, then press the ENTER key.

V4 The display will show:

n V C A L H I G H
The high calibration voltage point is calibrated. By pressing the ENTER key again, the high voltage setting is made active. The display shows:

n V C A L

V5 The high voltage can now be measured with the DMM. Check that the power supply is in the Constant Voltage mode. This is indicated on the display with the annunciator above the text CV. Enter the measured high value with the numeric keys, then press the ENTER key.

■ If the output channel is not able to operate in the CV mode, there is another load connected to the output channel, putting it in the CC mode; therefore, disconnect the other load to allow the output channel to enter the CV mode of operation.

■ If the entered measured value is out of the expected range, the display will show:

n V C A L E R R O R
In this case measure the high voltage with the DMM again, and enter the measured value, then press the ENTER key.

I1 The display shows:

n I C A L L O W
First the low calibration current point is calibrated.

I2 Press the ENTER key again to make the low current setting active. The display shows:

n I C A L

I3 The low current can now be measured with the DMM. Check that the power supply is in the Constant Current mode. This is indicated on the display with the annunciator above the text CC. Enter the measured low value with the numeric keys, then press the ENTER key.

■ If the output channel is not able to operate in the CC mode, check that the DMM is in the current range to allow the output channel to enter the CC mode of operation.

■ If the entered measured value is out of the expected range, the display will show:

n I C A L E R R O R
In this case measure the low current with the DMM again, and enter the measured value, then press the ENTER key.

I4 The display will show:

n I C A L H I G H
The high calibration current point is calibrated. Press the ENTER key again to make the high current setting active. The display shows:

n I C A L

I5 The high current can now be measured with the DMM. Check that the power supply is in the Constant Current mode. This is indicated on the display with the annunciator above the text CC. Enter the measured high value with the numeric keys, then press the ENTER key.

- If the output channel is not able to operate in the CC mode, check that the DMM is in the current range to allow the output channel to enter the CC mode of operation.

- If the entered measured value is out of the expected range, the display will show:

  n ICAL ERROR
  In this case measure the high current with the DMM again and enter the measured value, then press the ENTER key.

- Disconnect the DMM.

OV1 After the correct value has been entered, the display shows:

n OVCAL LOW
Now the overvoltage settings must be calibrated. This is achieved by pressing the ENTER key. The calibration of the low and high overvoltage points will be done automatically by displaying the following messages sequentially:

n MEASURE LOW
n MEASURE HIGH
n SAVING OFF
If there is something connected to the output channel that disturbs the measurements, the display will show:

n OVPCAL ERROR
If this is the case, remove the disturbance from the output channel. The measurements will resume when the ENTER key is pressed.

OV2 Now there are two options before the calibration session for this output channel is ended:

I The new calculated calibration data is saved. To do this, press the ON (1) key.
The display shows sequentially:

n SAVIN

n SAVE COMPLETED
Press the ENTER key. The display shows:

n CALIBRATE ON

II The new calculated calibration data is cancelled. To do this, press the ENTER key.

- The procedure can be repeated for another output channel (only applicable for multiple output units). Therefore, use the select key select the output channel (n) to be calibrated, and continue with procedure step V1.

- When all output channels have been calibrated, leave the calibration mode by pressing the OFF (0) key.

The display will show:

n STANDBY

6.2.2 Remote calibration procedure

In this procedure sending commands and queries is indicated as follows:

send --> command/query.

Reading of response data when a query has been sent is indicated as follows:

read <-- response.

This procedure must be followed sequentially and consists of the following programming steps:

- send --> *RST — resets instrument
- send --> :INST:STAT ON — sets OPERATE mode
- send --> :SYST:UNPR ON — enables to unprotect calibration
- send --> :SYST:UNPR:SEL 2812 — unprotects the calibration of the power supply by sending the password as calibration access code; default = 2812

If the password was not correct, error code -221 (Settings conflict) will be generated. This error can be read using the :SYST:ERR? query.

- send --> :SYST:UNPR:SEL? — check that the power supply is in the CAL mode; the response must be: CAL
- send --> :INST:NSEL 1 — selects output channel 1
- send --> :OUTP:STAT ON — enables output channel 1
- send --> :CAL:STAT OFF — disables the calibration data to be used

V1 Connect the DMM to the +V and -V terminal of the output channel to be calibrated. The DMM must be in the voltage range.
Program the current at approximately 10 % of its maximum as follows:
send --> :CURR:LIM:HIGH?
read <-- <max-current> — calculates 10 % of maximum current
send --> :CURR <max-current>/10
To calibrate the output voltage, the output channel must be in the CV mode, i.e., the annunciator above the text CV must be displayed.

V2 Program the low output voltage as follows:
send --> :VOLT MIN
Check that the output channel mode is VOLT as follows:
send --> :FUNC:MODE?
read <-- VOLT

V3 The low voltage can now be measured with the DMM. Enter the measured low value <low-volt> as follows:
send --> :CAL:VAL <low-volt>

V4 Program the high output voltage as follows:
send --> :VOLT MAX
Check that the output channel mode is VOLT as follows:
send --> :FUNC:MODE?
read <-- VOLT

V5 The high voltage can now be measured with the DMM. Enter the measured high value <high-volt> as follows:
send --> :CAL:VAL <high-volt>

I1 Program the voltage at approximately 10 % of its maximum as follows:
send --> :VOLT:LIM:HIGH?
read <-- <max-voltage> calculates 10 % of maximum voltage
send --> :VOLT <max-voltage>/10
Set the DMM in the current range, so that currents can be measured. To calibrate the output current the output channel must be in the CC mode, i.e. the annunciator above the text CC must be displayed.

I2 Program the low output voltage as follows:
send --> :CURR MIN
Check that the output channel mode is CURR as follows:
send --> :FUNC:MODE?
read <-- CURR

I3 The low current can now be measured with the DMM. Enter the measured low value <low-curr> as follows:
send --> :CAL:VAL <low-curr>

I4 Program the high output current as follows:
send --> :CURR MAX
Check that the output channel mode is CURR as follows:
send --> :FUNC:MODE?
read <-- CURR

I5 The high current can now be measured with the DMM. Enter the measured high value <high-curr> as follows:
send --> :CAL:VAL <high-curr>

■ Disconnect the DMM.

OV1 Program the current at approximately 10 % of its maximum as follows:
send --> :CURR:LIM:HIGH?
read <-- <max-current> calculates 10 % of maximum current
send --> :CURR <max-current>/10
To calibrate the overvoltage, the output channel must be in the CV mode, i.e., the annunciator above the text CV must be displayed.

OV2 Check that the output channel mode is VOLT as follows:
send --> :FUNC:MODE?
read <-- VOLT

OV3 Start the automatic calibration of the overvoltage as follows:
send --> :CAL:AUTO ONCE executes the overvoltage calibration (this will last some time)
send --> :CAL:STAT ONenables the calibration data to be used
The calculation and storage of the calibration data will last about 5 seconds.

■ The procedure can be repeated for another output channel (only applicable for multiple output units). Therefore select the output channel (n) to be calibrated as follows:
send --> INST:NSEL nn = the number of the output channel
Continue with procedure step V1.

■ When all output channels have been calibrated, terminate the calibration mode as follows:
send --> :OUTP:STAT OFF disables the selected output channel
send --> :SYST:UNPR OFF disables the unprotection of the calibration, i.e. the next calibration is protected again

7 CORRECTIVE MAINTENANCE PROCEDURES

7.1 HARDWARE-ERROR MESSAGES:

The hardware errors, which may occur at power-on during the selftest, are reported as an error number. The source of the errors can be the main CPU or the AD-DA CPU. The display shows:

ERROR n:XYZ

The error code consists of an error source indication n and an error type indication XYZ.

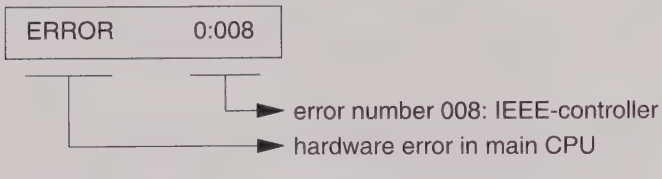
n: 0 = main CPU error

XYZ: for main CPU

The error code is equal to the sum of the decimal equivalent of the following bits:

BIT	NUMBER	DESCRIPTION
B(7)	128	display-controller-fail
B(6)	64	bank-switch-error
B(5)	32	(not used)
B(4)	16	DDB-fail
B(3)	8	IEEE-controller-fail
B(2)	4	processor-timer-fail
B(1)	2	RAM-fail
B(0)	1	ROM-fail

Example:
If the IEEE-controller-test failed, the display shows:



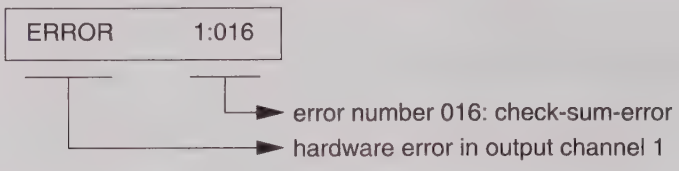
n: 1 = AD-DA CPU error of output 1
2 = AD-DA CPU error of output 2
3 = AD-DA CPU error of output 3
(in general: n is the output number)

XYZ: for AD-DA CPU

The error code is equal to the sum of the decimal equivalent of the following bits (except for the PON bit):

BIT	NUMBER	DESCRIPTION
B(7)	128	power-on-detected
B(6)	64	ROM check-sum-error
B(5)	32	CONFIG check-sum-error
B(4)	16	CAL check-sum-error
B(3)	8	DEFSET check-sum-error
B(2)	4	processor-timer-fail
B(1)	2	(not used)
B(0)	1	slave not responding

Example:
If there is a CAL check-sum-error, the display will show:



7.2 TROUBLESHOOTING

7.2.1 Introduction

The following information is provided to facilitate troubleshooting.
Information contained in other sections of the manual should also be used to assist in faultfinding. A thorough understanding of the circuit is helpful in locating faults, particularly where integrated circuits are used.
Refer to the circuit description for this information.

7.2.2 CPU PCB

Function LED H101:
LED H101 will be on when one of the following tests (1 to 7) fail.

Free run test
- Switch off the PPS
- Put jumper X106 in position 1-2 to disable the watchdog
- Put jumper X107 in position 2-3 to select the free run test

Signals on the Address lines:
When starting on address line A15, the frequency should double on each following lower address line

Data lines:
Check to see if there is activity on the data bus lines. The levels should be "0" or "1" and there should be no tree state level.

Diagnostic tests
- Switch off the power
- Replace jumpers X106 and X107 in the original positions
- Keep S101 depressed during switching on till the display shows: INITIALISING

After the initialisation, the display will show: DIAGNOSTICS ON. Now press S101 to start the next test.

TEST	DESCRIPTION	RESULT
1	ROM test	passed/failed
2	RAM test	passed/failed
3	IEEE IC test	passed/failed
4	micro-processor timer test	passed/failed
5	DDB bus test	passed/failed
6	display controller test	passed/failed
7	display test 1 (chess board)	visual control
	display test 2 (chess board + annunciators)	visual control

7.2.3 AD-DA PCB

Function LED H303

LED H303 is used to indicate the state of functioning of the AD-DA PCB.

LED off	no power for the AD-DA or the microprocessor does not run.
LED burning softly	normally functioning of the PCB
LED blinking ≥ 5 s	no communication with the CPU PCB

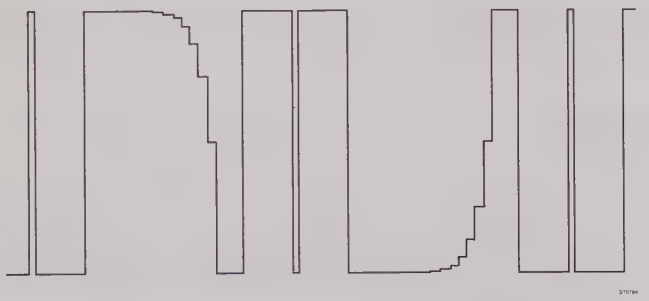
Test voltages during normal functioning:

Ioutput [A]	TP306 RBC (on PCB marked RC) [V]
0	0
maximum	5

Voutput [V]	TP307 RBV (on PCB marked RV) [V]
0	0
maximum	5

Selecting the test mode:
- Switch off the power
- Interconnect solder spot SEL5 on the AD-DA PCB
- Switch off the watchdog by interrupting the solder spot WD on the AD-DA PCB
- Switch on the power

Test voltages in the test mode:
All DAC outputs should show the same output signal:



Signal on TP308, TP309, TP310 and TP311

7.3 REPLACEMENTS

7.3.1 Standard parts

Electrical and mechanical parts replacements can be obtained through your local FLUKE/PHILIPS organization or representative. However, many of the generic electronic components can be obtained from other sources. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

NOTE: Physical size and shape of a component may affect instrument performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade the instrument performance.

7.3.2 Special parts

In addition to the standard electronic components, some special components are used:
- Components, custom manufactured or selected by PHILIPS to meet specific performance requirements.
- Components that are important for the safety of the instrument.

NOTE: Both types of components may be replaced only by components obtained through your local FLUKE/PHILIPS organization or representative.

7.3.3 Transistors and integrated circuits

- Return transistors and integrated circuits to their original positions if they were removed during routine maintenance.

- Do not replace or swap semiconductor devices unnecessarily, because the change may affect the calibration of the instrument.

- Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket or pcb holes, and cut the leads to the same length as on the component being replaced.

- When a device has been replaced, check the circuit that may be affected for proper operation. See also the performance verification procedures in section 4 of this manual.

7.4 RECALIBRATION AFTER REPAIR

After any electrical component has been replaced, the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuits.

7.5 INSTRUMENT REPACKING

If the instrument is to be reshipped to a Service Center for service or repair, attach a tag showing the full address and the name of the individual at the users firm that can be contacted. The Service Center needs the complete instrument, its serial number, and a complete description of the problem and the work that is to be performed. If the original container is not available, repack the instrument in such a way that no damage occurs during transport.

8 SAFETY INSPECTION AND TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

8.1 GENERAL DIRECTIONS

- Take care that the original distances and clearances are not reduced.
- Before soldering, bend the wires through the holes of the solder leads, or wrap the wires around the leads in the form of an open U, or, maintain wiring rigidity by cable clamps or cable lacing.

8.2 SAFETY COMPONENTS

For safety reasons the input and power units are in the G2 procedure. They can only be repaired in the factory.

8.3 CHECKING PROTECTIVE GROUND

The correct connection and condition is checked visually and by measuring the resistance between the protective ground connection at the plug and the cabinet/frame. The resistance shall be less than 0,5Ω, test current 25A. During measurement the line power cable should be removed. Resistance variations indicate a defect.

8.4 CHECKING INSULATION RESISTANCE

Measure the insulation resistance at U = 500 V dc between the line connections and the protective ground connection. For this purpose set the ON/OFF switch to ON. The insulation resistance shall not be less than 2 MΩ.

NOTE: The insulation resistance of 2 MΩ is a minimum requirement at 40° C and 95% relative humidity. Under normal conditions the insulation resistance should be much higher (10 to 20 MΩ).

8.5 CHECKING LEAKAGE CURRENT

The leakage current shall be measured between each pole of the line power supply in turn, and all accessible conductive parts connected together (including the measuring ground terminal).

The leakage current is not excessive if the measured current from the mentioned parts is ≤ 0,5 mA rms (without filter capacitor) or ≤ 3.5 mA rms (with filter capacitor).

8.6 VOLTAGE TEST

The instrument shall withstand, without electrical breakdown, the application of a test voltage between the supply circuit and accessible conductive parts that are likely to become energized.

The test potential shall be 1500 V rms or dc equivalent at supply-circuit frequency, applied for one second. The test shall be conducted when the instrument is fully assembled, and with the primary switch in the ON position. During the test, both sides of the primary circuit of the instrument are connected together and to one terminal of the voltage test equipment; the other voltage test equipment terminal is to be connected to the accessible conductive parts.

9 PARTS LIST

POSNR.	DESCRIPTION	ORDERING CODE
FUSES		
F 0001	T 5X20 3.15A	4822 253 30027
F 0002	T 5X20 3.15A	4822 253 30027
F 0003	T 5X20 3.15A	4822 253 30027
GENERAL		
M 1	FAN 24VDC	5322 361 10594
X 0001	INPUT FILTER/FUSE HOLDER	5322 121 43843
X 2005	TERMINAL STRIP 4P	5322 290 61001
	PROT COVER INPUT	5322 464 50838
	JUMPER OUTPUT CONNECTOR	5322 401 11391
	SCREW OUTPUT CONNECTOR	5322 403 40162
	INPUT MODULE)*, unit A4	5322 216 23557
	POWER MODULE 30V/10A)*	5322 218 41048
	POWER MODULE 60V/5A)*	5322 214 90611
	)* IN THE G2 PROCEDURE	
HOUSING		
	FRONT PLATE SINGLE PPS	5322 447 91883
	FRONT PLATE DOUBLE/TRI PPS	5322 464 50837
	TEXT PLATE PM2811/01	5322 454 21033
	TEXT PLATE PM2811/11	5322 460 60554
	TEXT PLATE PM2812/01	5322 454 21026
	TEXT PLATE PM2812/11	5322 454 21027
	TEXT PLATE PM2812/21	5322 454 21028
	TEXT PLATE PM2812/31	5322 454 21029
	TEXT PLATE PM2812/41	5322 454 21031
	TEXT PLATE PM2813/01	5322 454 21034
	TEXT PLATE PM2813/11	5322 454 21032
	TEXT PLATE PM2813/21	5322 456 10021
	TEXT PLATE PM2813/31	5322 456 10022
	REAR FOOT (PLASTIC)	5322 462 41747
	INSERT REAR FOOT	5322 462 41201
	FOOT LOWER SIDE	5322 462 41712
	INSERT FOOT LOWER SIDE	5322 462 44148
	STANDUP ARM LEFT (FOOT)	5322 405 91478
	STANDUP ARM RIGHT (FOOT)	5322 405 91479
	HOUSING SINGLE PPS	5322 466 82778
	HOUSING DOUBLE/TRIPLE PPS	5322 466 82779
PARTS OUTPUT ON THE FRONT PANEL		
	OUTPUT CONNECTOR RED	5322 268 20211
	OUTPUT CONNECTOR BLACK	5322 268 20212

C 0001	± 10% 470NF 250 V	5322 121 70022
S 0001	SWITCH SENSE/OUTPUT	5322 277 10974

CABLE LOOMS

BK2	FLAT CABLE DISPLAY	5322 321 61077
BK3	FLAT CABLE CPU/AD-DA 1 MOD	5322 321 61078
BK4	FLAT CABLE CPU/AD-DA 2 MOD	5322 321 61082
BK5	FLAT CABLE CPU/AD-DA 3 MOD	5322 321 61085
DB1	CABLE LOOM 220V	5322 321 61076
DB2	CABLE LOOM 24V 1 MOD	5322 321 61079
DB3	CABLE LOOM 300V 1 MOD	5322 321 61081
DB4	CABLE LOOM 24V 2 MOD	5322 321 61083
DB5	CABLE LOOM 300V 2 MOD	5322 321 61084
DB9	CABLE LOOM 24V 3 MOD	5322 321 61086
DB10	CABLE LOOM 300V 3 MOD	5322 321 61087

CPU PCB, unit A1

A 100	CPU PCB	5322 214 90603
A 101	PROM CPU	5322 209 51991
A 102	PAL A102	5322 209 51992
A 103	PAL A103	5322 209 51993

CAPACITORS

C 0101	100V 10% 100NF	5322 122 10468
C 0102	-20+50% 10NF	4822 122 31414
C 0103	-20+80% 22NF	4822 122 30103
C 0104	-20+50% 10NF	4822 122 31414
C 0105	100V 10% 100NF	5322 122 10468
C 0106	-20+50% 10NF	4822 122 31414
C 0107	100V 10% 100NF	5322 122 10468
C 0108	-20+80% 22NF	4822 122 30103
C 0109	-20+80% 22NF	4822 122 30103
C 0110	-20+80% 22NF	4822 122 30103
C 0111	-20+50% 10NF	4822 122 31414
C 0112	100V 10% 100NF	5322 122 10468
C 0113	-20+80% 22NF	4822 122 30103
C 0114	-20+80% 22NF	4822 122 30103
C 0115	20% 10UF	5322 124 21731
C 0116	-20+80% 22NF	4822 122 30103
C 0117	10% 1NF	5322 122 32331
C 0118	-20+80% 22NF	4822 122 30103
C O119	2% 33PF	5322 122 32072
C 0120	2% 33PF	5322 122 32072
C 0121	10% 1NF	5322 122 32331
C 0122	104 1NF	5322 122 32331
C 0123	20% 10UF	5322 124 21731
C 0124	20% 1UF	5322 124 41098
C 0125	20% 330UF	5322 124 22095

DIGITAL INTEGRATED CIRCUITS

D 0101	CPU N80C196KB12 INT	4822 209 63502
D 0102	RAM PC74HC4060P PEL	5322 209 11196
D 0103	PC74HC573P PEL	5322 209 83271
D 0104	PC74HC573P PEL	5322 209 83271
D 0105	M622561P-12 HIT	5322 209 72129
D 0106	SAA1045P PEL	5322 209 83269
D 0107	P8291A INT	5322 209 81264
D 0108	DS75161AN NSC	4822 209 63506
D 0109	DS75160AN NSC	4822 209 63507
D 0110	D575161AN NSC	4822 209 63506
D 0111	PC74HC03P PEL	5322 209 73028
D 0112	PC74HC30P PEL	5322 209 73029

CRYSTAL

G 0101	CRYSTAL 12.0 MHZ	4822 242 71663

BATTERY

G 0102	LITHIUM BATTERY	5322 138 10223

OPTO DEVICE

H 0101	TLHR4613 AEG	5322 130 81522

CHOKES

L 0102	47UH TDK	4822 152 10106
L 0103	1000UH TDK	5322 157 52718

ANALOG INTEGRATED CIRCUIT

N 0101	TL7705ACP T.I	4822 209 82386

RESISTORS

R 0102	MRS25 1% 46K4	4822 050 24643
R 0103	MRS25 1% 22K6	5322 116 82834
R 0104	MRS25 1% 1K	4822 050 21002
R 0105	MRS25 1% 3K32	4822 050 23322
R 0106	MRS25 1% 10K	4822 050 21003
R 0107	MRS25 1% 1K	4822 050 21002
R 0108	MRS25 1% 12K1	4822 050 21213
R 0109	MRS25 1% 8K25	4822 050 28252
R 0110	MRS25 1% 121E	4822 050 21211
R 0111	-105-103 10K	5322 111 90473
R 0112	MRS25 1% 10K	4822 050 21003
R 0113	MRS25 1% 100K	4822 050 21004
R 0114	MRS25 1% 1K	4822 050 21002
R 0118	-105-104 100K	5322 111 50559

SWITCH

S 0101	1-P	5322 276 11577

DIODES

V 0101	BAW62 PEL	4822 130 30613
V 0102	BAW62 PEL	4822 130 30613
V 0103	BAW62 PEL	4822 130 30613

CONNECTORS

X 0101	24-P SKT IEEE	5322 265 51304
X 0102	P 90 DEGR. QF50	5322 265 40715
X 0103	P 90 DEGR. QF50	5322 265 51303
X 0106	3-P SNG 2.54	5322 265 30392
X 0107	3-P SNG 2.54	5322 265 30392
X 0108	PCB RECEPTACLE	5322 267 10268
X 0109	PCB RECEPTACLE	5322 267 10268
X 0110	PCB RECEPTACLE	5322 267 10268

KEYBOARD & DISPLAY PCB, unit A2

A 200	KEYBOARD & DISPLAY PCB	5322 214 90604

CAPACITORS

C 0201	10% 10NF	5322 122 34098
C 0202	10% 10NF	5322 122 34098
C 0203	10% 10NF	5322 122 34098
C 0204	10% 10NF	5322 122 34098
C 0205	-20+20% 15UF	5322 124 11068

DIGITAL INTEGRATED CIRCUITS

D 0201	PC74HC573T PEL	5322 209 60424
D 0202	PC74HC573T PEL	5322 209 60424
D 0203	HD44780 HIT	4822 209 63282
D 0204	HD44100H HIT	5322 209 63509

OPTO DEVICES

H 201	LCD	5322 130 90948
H 202	LCD BACKLIGHT	5322 216 41102

RESISTORS

R 0201	RC-02H 1% 10K	5322 116 80428
R 0202	RC-02H 1% 10K	5322 116 80428
R 0203	RC-02H 1% 10K	5322 116 80428
R 0204	RC-02H 1% 10K	5322 116 80428
R 0205	RC-02H 1% 10K	5322 116 80428
R 0206	RC-02H 1% 10K	5322 116 80428
R 0207	90K90 1% 0.6W	4822 050 29093
R 0208	RC-02H 1% 6K81	5322 116 80686

R 0209	RC-02H 1% 6K81	5322 116 80686
R 0210	RC-02H 1% 100E	5322 116 80426
R 0211	RC-02H 1% 6K81	5322 116 80686
R 0212	RC-02H 1% 6K81	5322 116 80686

GENERAL

	LCD WINDOW	5322 459 20578
	CONNECTING RUBBER	5322 267 70298
	KEYPAD	5322 218 61443

AD-DA PCB, unit A3

A 300	AD-DA PCB	5322 214 90602
A 301	PROM AD-DA	5322 209 51994

CAPACITORS

C 0301	-20+50% 10NF	4822 122 31414
C 0302	-20+50% 10NF	4822 122 31414
C 0303	-20+80% 22NF	4822 122 30103
C 0304	-20+50% 10NF	4822 122 31414
C 0305	10OV 10% 100NF	5322 122 10468
C 0306	-20+80% 22NF	4822 122 30103
C 0307	-20+80% 22NF	4822 122 30103
C 0308	-20+50% 10NF	4822 122 31414
C 0310	20% 22UF	5322 124 41381
C 0311	10OV 10% 100NF	5322 122 10468
C 0312	20% 22UF	5322 124 41381
C 0313	20% 22UF	5322 124 41381
C 0314	20% 22UF	5322 124 41381
C 0315	20% 22UF	5322 124 41381
C 0316	2% 33PF	5322 122 32072
C 0317	2% 33PF	5322 122 32072
C 0318	63V 10% 100NF	5322 121 42386
C 0319	63V 10% 100NF	5322 121 42386
C 0320	63V 10% 100NF	5322 121 42386
C 0321	63V 10% 100NF	5322 121 42386
C 0322	-20+80% 22NF	4822 122 30103
C 0323	20% 10UF	5322 124 21731
C 0324	20% 1UF	5322 124 41098
C 0325	-20+80% 22NF	4822 122 30103
C 0327	2% 15PF	4822 122 31823
C 0328	2% 15PF	4822 122 31823
C 0329	20% 10UF	5322 124 21731
C 0330	10OV 10% 100NF	5322 122 10468
C 0331	-20+50% 10NF	4822 122 31414
C 0332	-20+50% 10NF	4822 122 31414
C 0333	2% 15PF	4822 122 31823
C 0334	-20+50% 10NF	4822 122 31414
C 0335	-20+50% 10NF	4822 122 31414

C 0336	20% 10UF	5322 124 21731
C 0337	100V 10% 100NF	5322 122 10468
C 0338	2% 15PF	4822 122 31823
C 0339	-20+80% 22NF	4822 122 30103
C 0340	-20+80% 22NF	4822 122 30103
C 0341	-20+50% 10NF	4822 122 31414
C 0342	-20+50% 10NF	4822 122 31414
C 0343	-20+80% 22NF	4822 122 30103
C 0344	-20+80% 22NF	4822 122 30103
C 0345	-20+80% 22NF	4822 122 30103
C 0346	-20+80% 22NF	4822 122 30103
C 0347	2% 100PF	4822 122 31316
C 0348	2% 100PF	4822 122 31316
C 0349	-20+50% 10NF	4822 122 31414
C 0350	-20+50% 10NF	4822 122 31414

DIGITAL INTEGRATED CIRCUITS

D 0301	SAA1045P PEL	5322 209 83269
D 0302	PCD8582DP PEL	5322 209 63038
D 0304	PC74HC573P PEL	5322 209 83271
D 0305	P80C31BH INT	5322 209 73932
D 0306	PC74HC573P PEL	5322 209 83271
D 0307	PC74HC138P PEL	5322 209 11335
D 0308	PC74HC00P PEL	5322 209 83218

CRYSTAL

G 0301	CRYSTAL 12.0 MHZ	4822 242 71663

OPTO DEVICES

H 0301	740L6010	5322 130 90538
H 0302	740L6010	5322 130 90538
H 0303	TLHR4613 AEG	5322 130 81522

ANALOG INTEGRATED CIRCUITS

N 0301	TL7705ACP T.I	4822 209 82386
N 0302	PM-7528HP PMI	5322 209 70351
N 0303	DAC-8248HP PMI	4822 209 63503
N 0304	OP-200GP PMI	5322 130 62553
N 0305	OP-200GP PMI	5322 130 62553
N 0306	OP-77GP PMI	5322 130 60937
N 0307	LM311N NSC	5322 209 85503
N 0308	LM311N NSC	5322 209 85503
N 0309	OP-200GP PMI	5322 130 62553

RESISTORS

R 0301	-105-103 10K	5322 111 90473
R 0302	-105-103 10K	5322 111 90473

R 0303	-105-103 10K	5322 111 90473
R 0304	MRS25 1% 2K74	4822 050 22742
R 0305	MRS25 1% 1K	4822 050 21002
R 0306	MRS25 1% 1K	4822 050 21002
R 0307	MRS25 1% 5K9	4822 050 25902
R 0309	1/4W 0.1% 5K	5322 116 80369
R 0310	1/4W 0.1% 5K23	5322 116 82832
R 0311	MRS25 1% 1K	4822 050 21002
R 0312	MRS25 1% 2K05	4822 050 22052
R 0313	MRS25 1% 2K05	4822 050 22052
R 0314	MRS25 1% 1K	4822 050 21002
R 0315	MRS25 1% 5K9	4822 050 25902
R 0316	MRS25 1% 23E7	5322 116 51701
R 0317	1/4W 0.1% 34K8	5322 116 82833
R 0318	MRS25 1% 110E	4822 050 21101
R 0319	MRS25 1% 22E6	4822 050 22269
R 0320	MRS25 1% 22E6	4822 050 22269
R 0321	MRS25 1% 1K	4822 050 21002

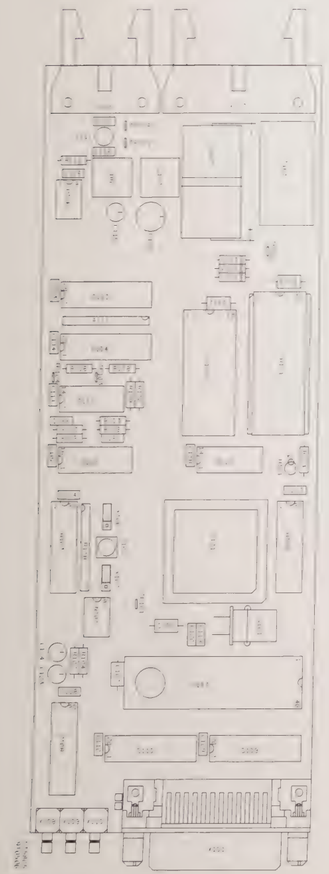
CONNECTORS

X 0301	P 90 DEGR. QF50	5322 265 40715
X 0303	5-P SNG RT.ANG	5322 265 30779

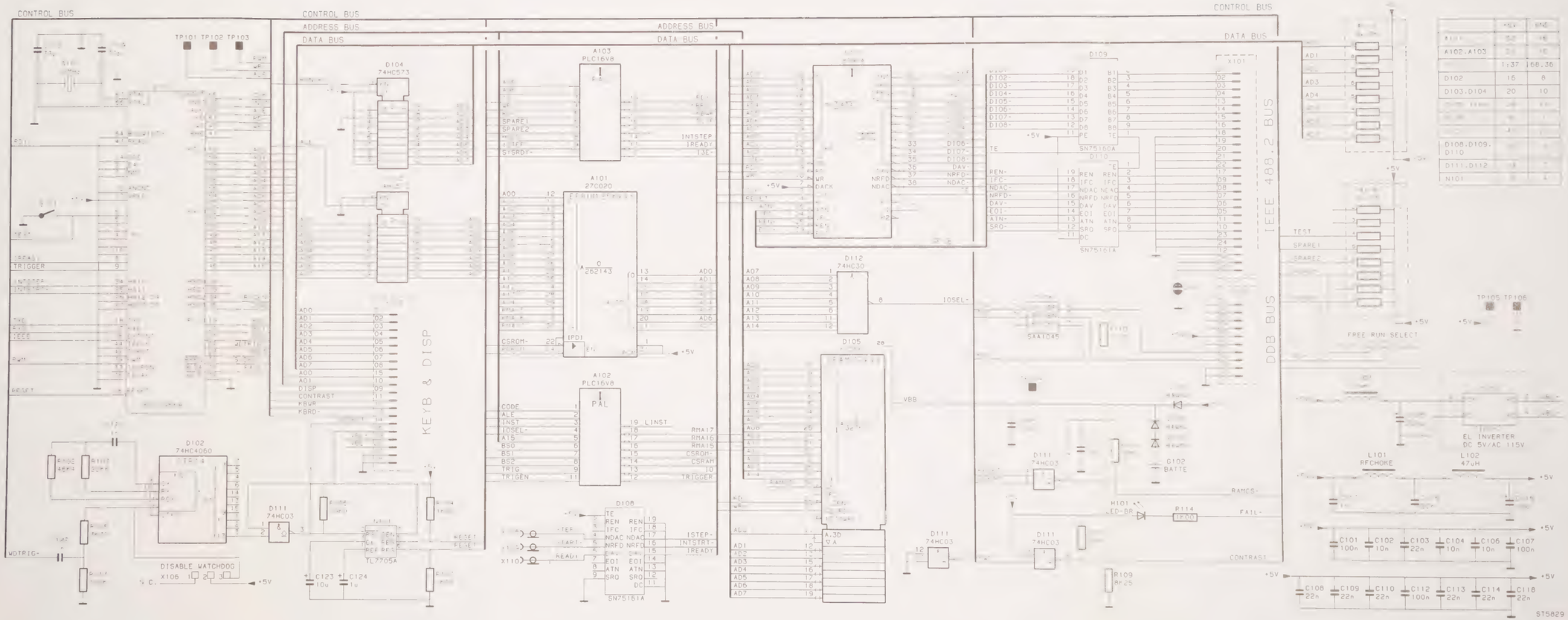
SOCKETS

	IC SOCKET 28-P	5322 255 44047
	CHIP HOLDER	5322 255 40677

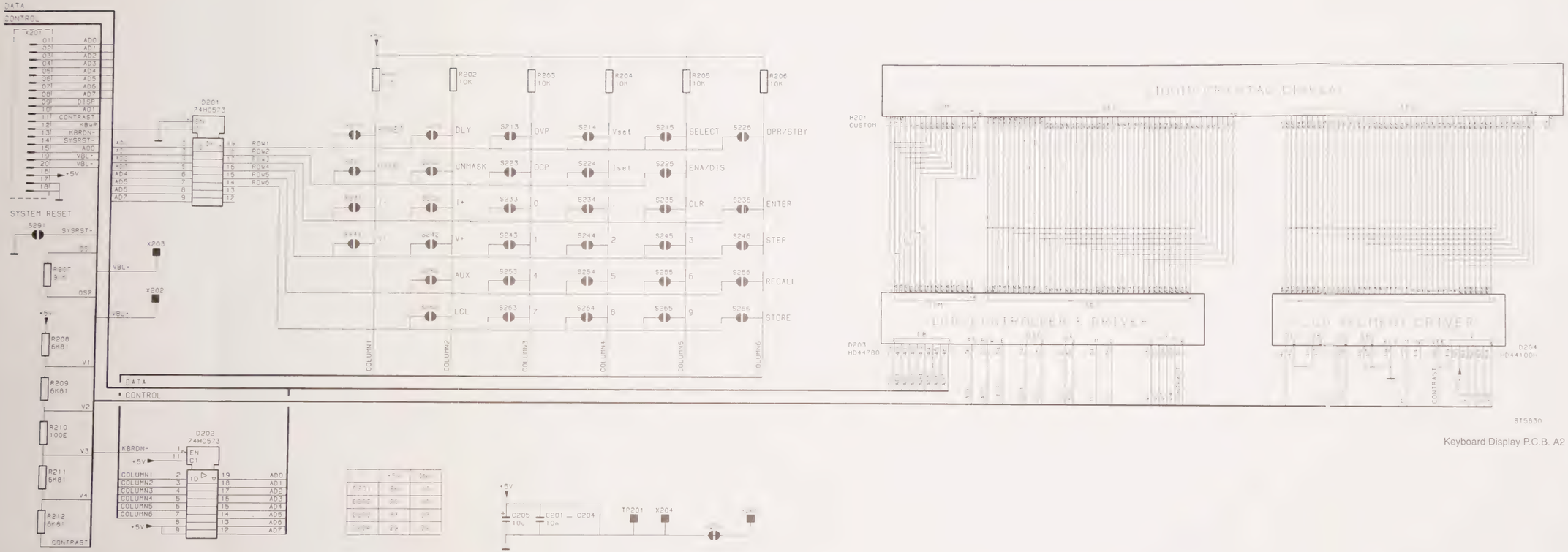
10 WIRING DIAGRAM



CPU P.C.B. A1. component side

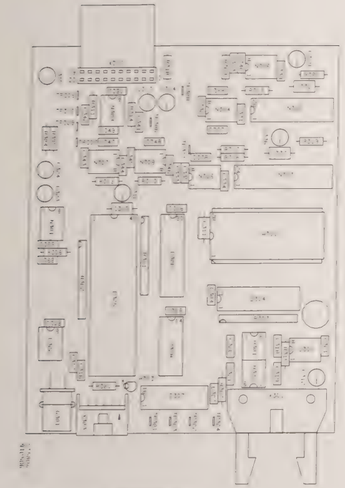


CPU P.C.B. A1

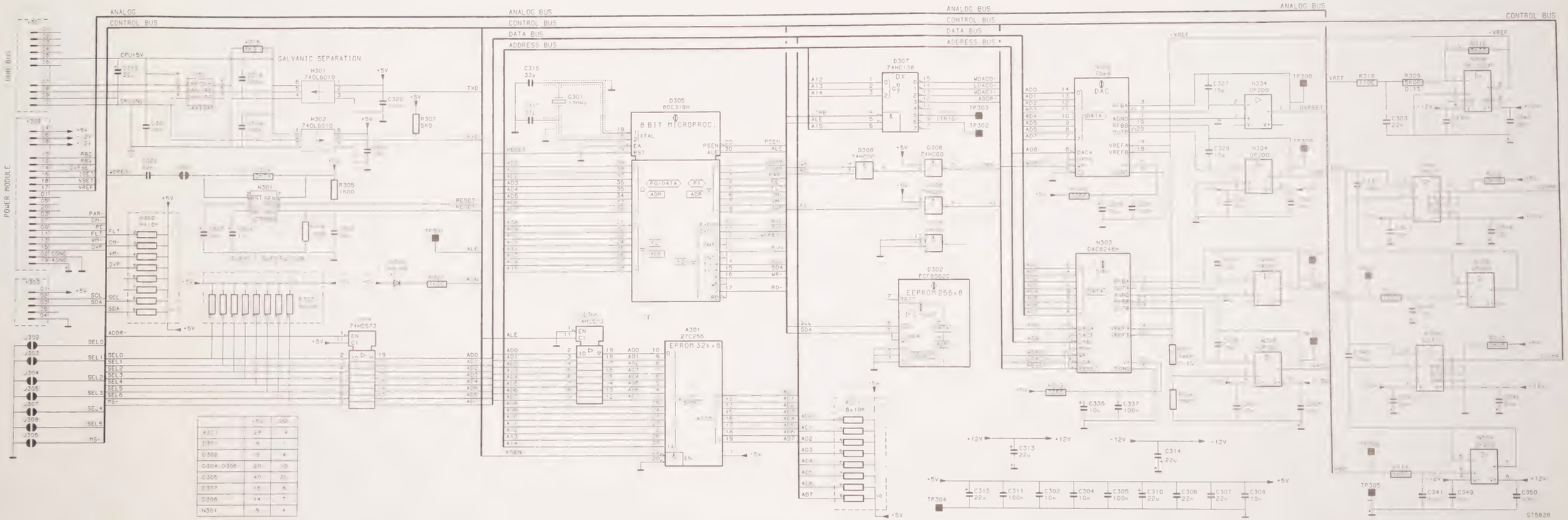


Keyboard Display P.C.B. A2

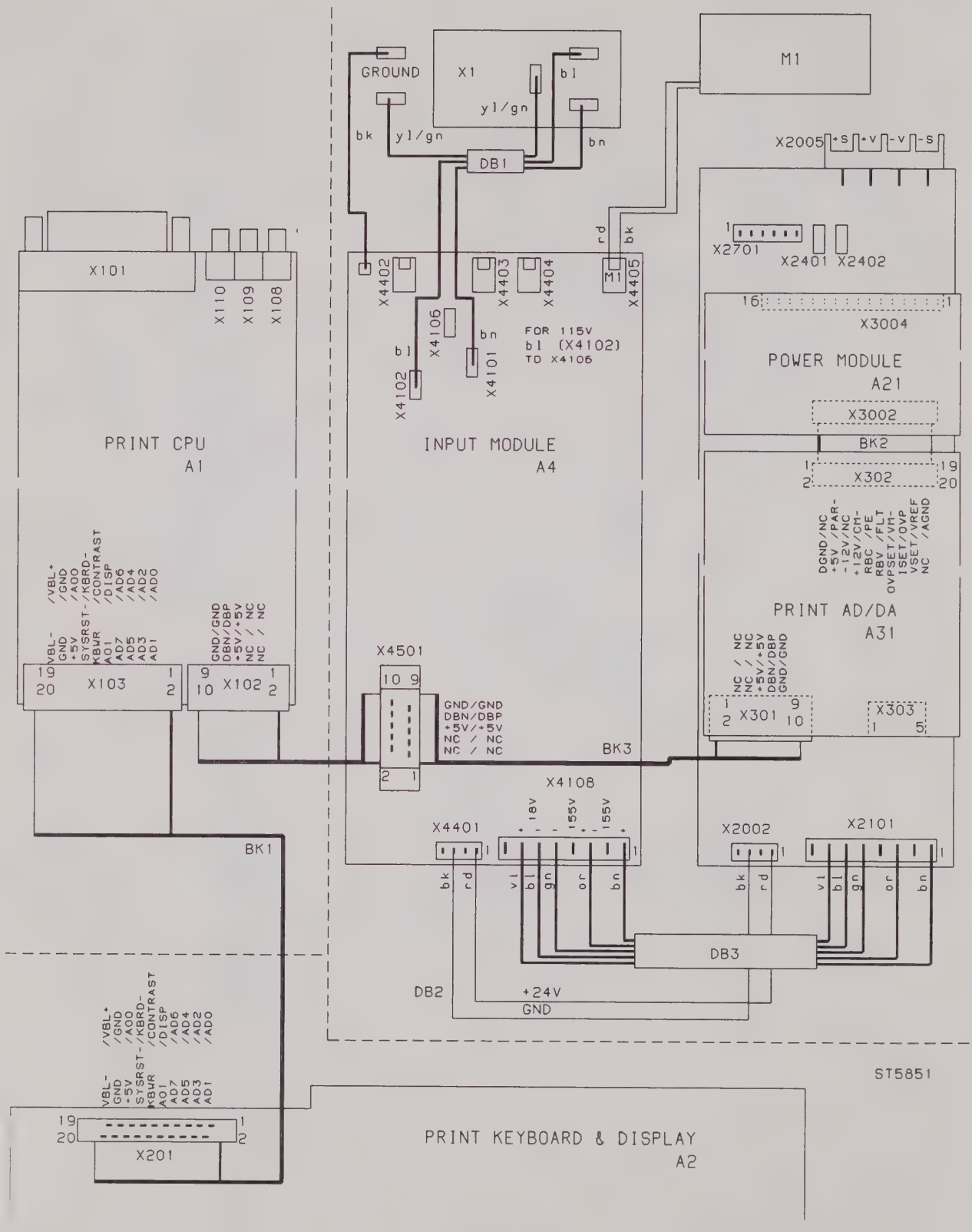
Keyboard Display P.C.B. A2, component side



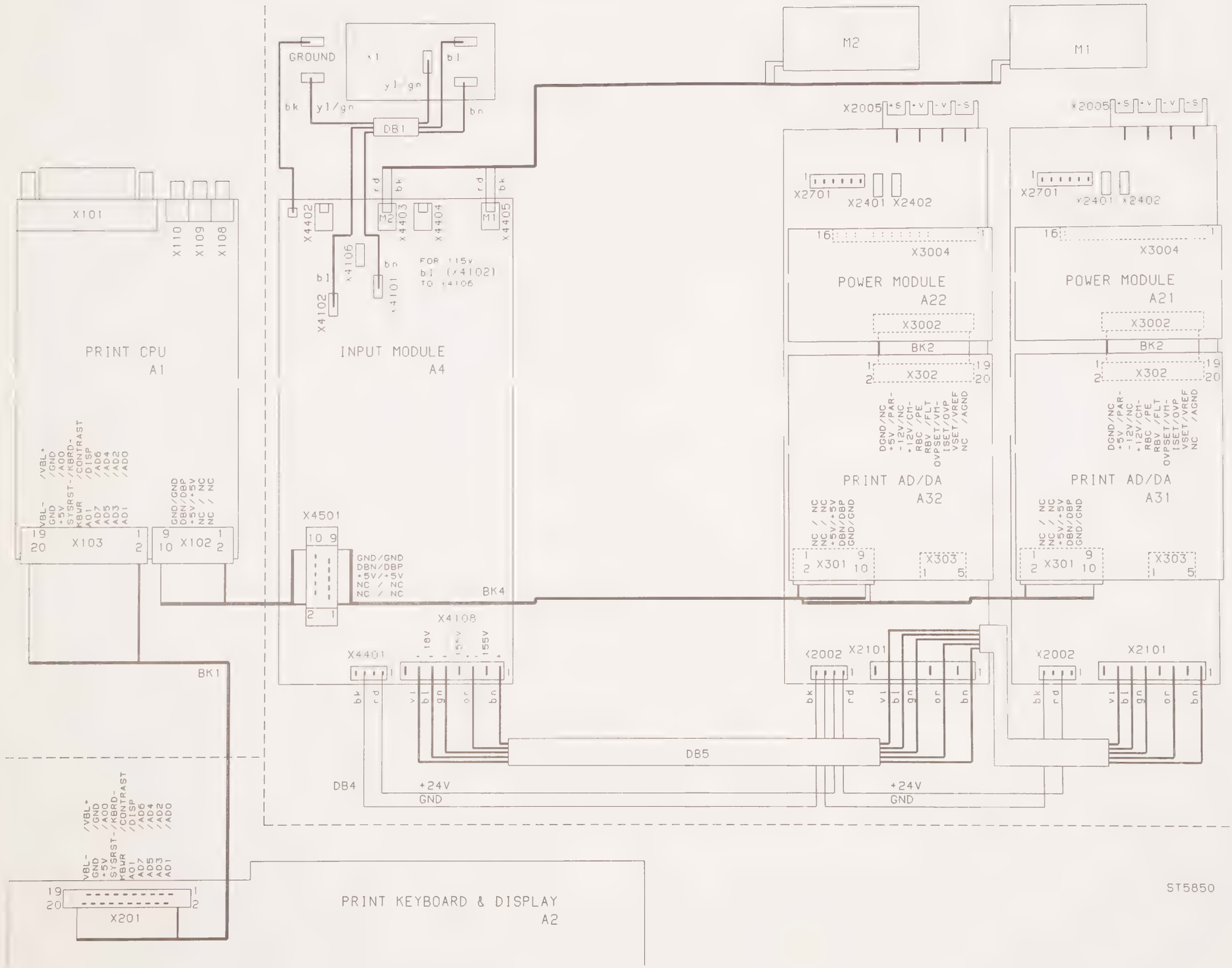
AD_DA P.C.B. A3 component side



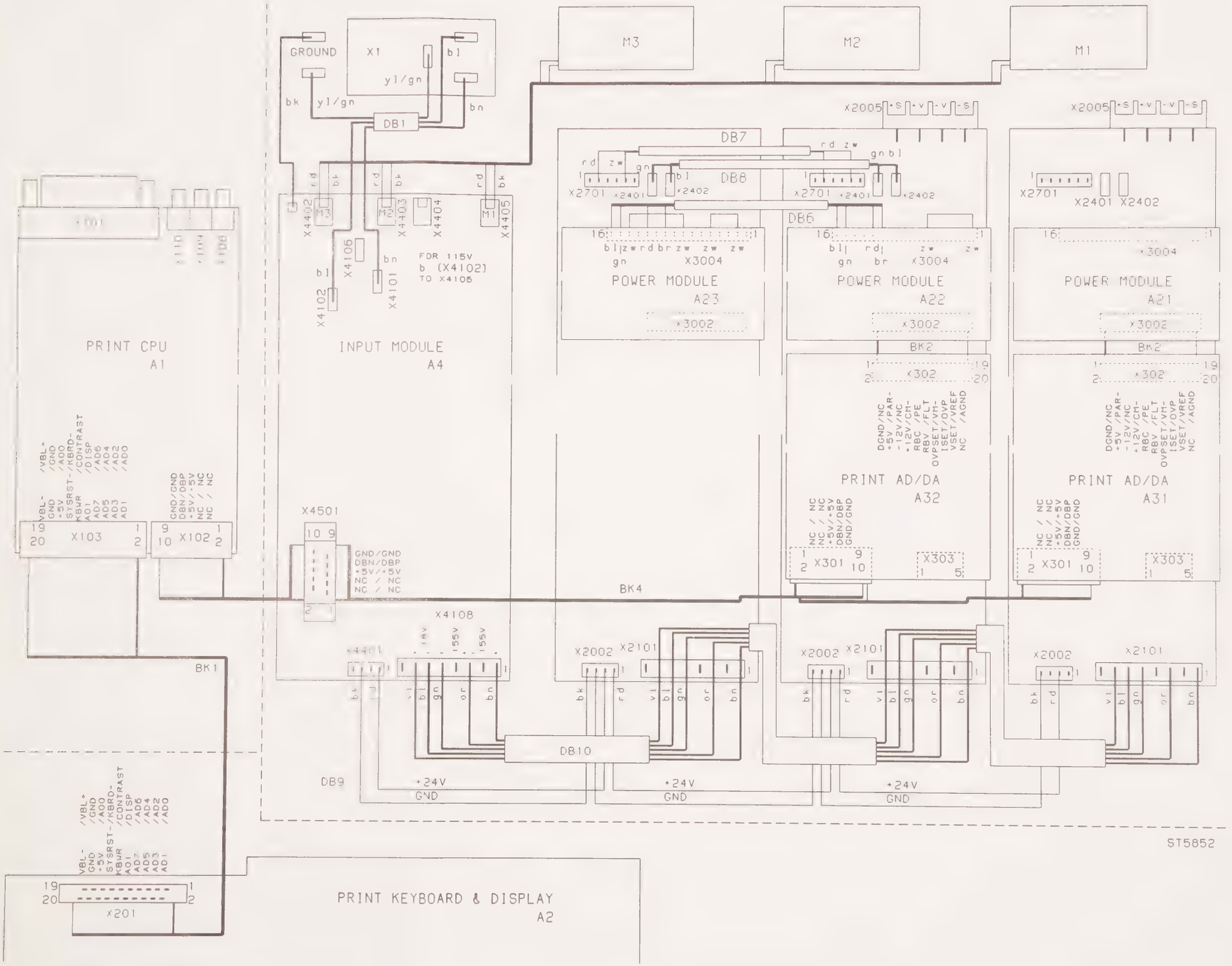
AD_DA P.C.B. A3



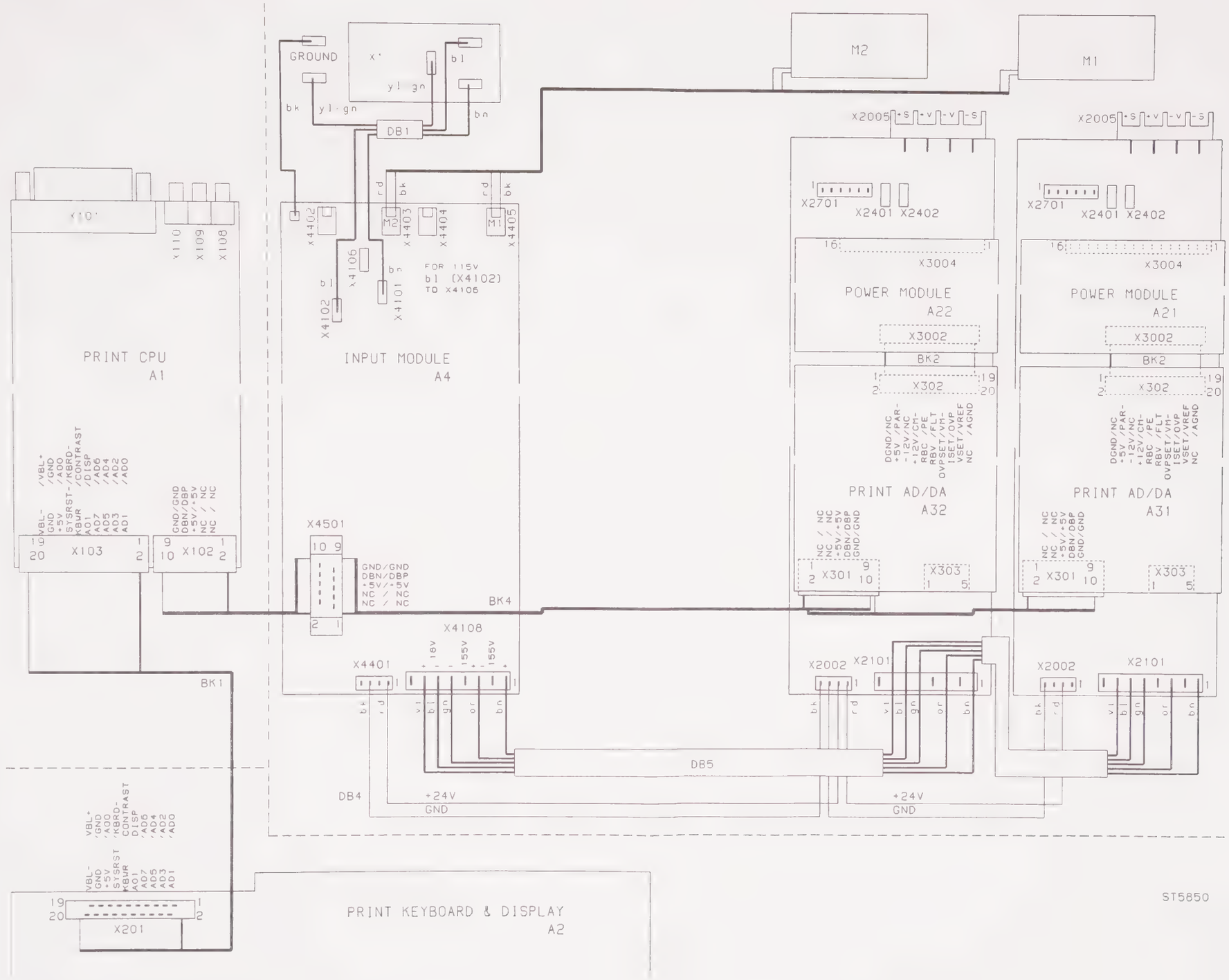
Interconnection diagram PM2811/**



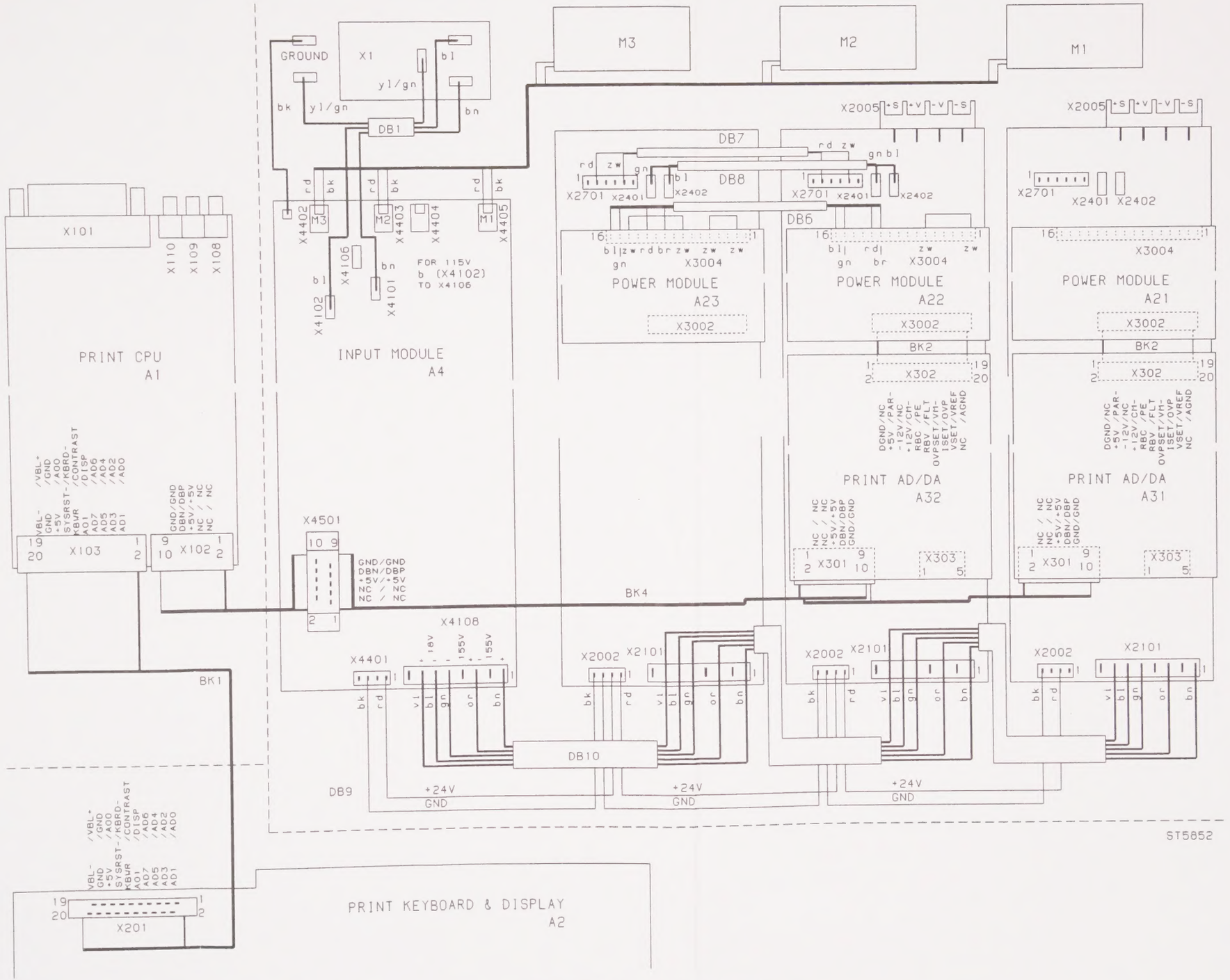
Interconnection diagram PM2812/0*,/1*,/2*



Interconnection diagram PM2812/3*,/4*



Interconnection diagram PM2812/0*,/1*,/2*



Interconnection diagram PM2812/3*,/4*

MP MASTER
MA30888